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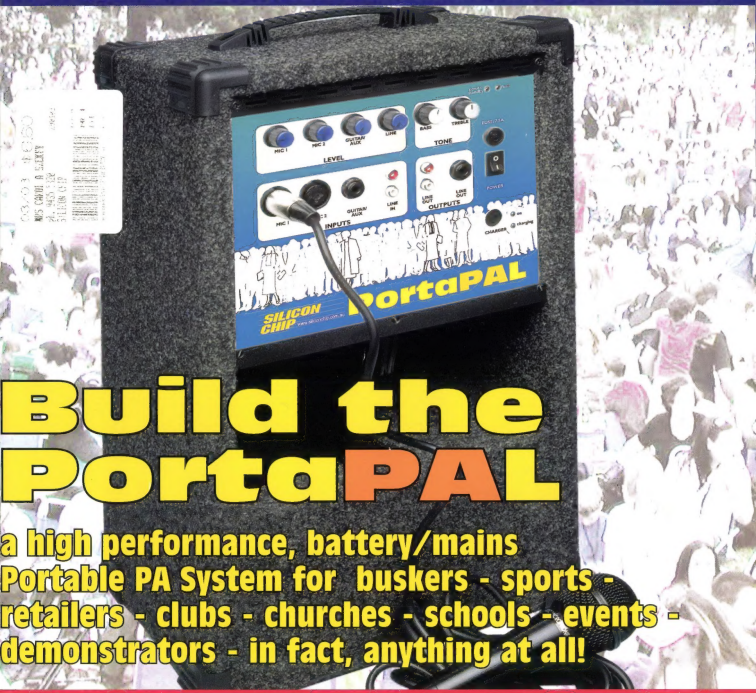

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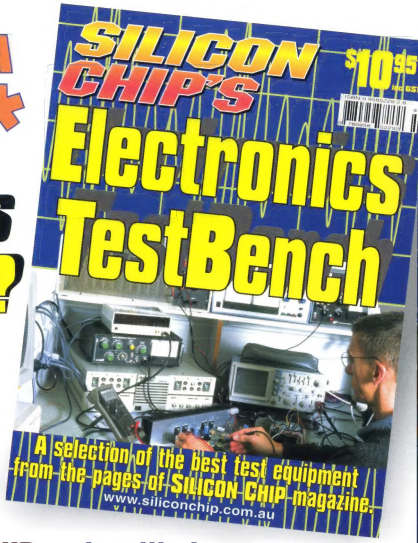

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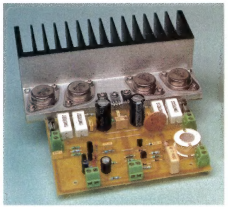

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PUBLISHER'S LETTER

Queensland TV repairs need a safety check, not a licence

Predictably, the Publisher's Letter in last month's issue has brought forth howls of anguish from all those affected by the new Queensland legislation requiring electronics servicemen to take out an electrical contractor's licence. I have had quite a few people phone me to rant about how unreasonable the new requirement is, how they might avoid it (they can't) and whether there are any sanctions (fines of up to $30,000).

In every case, I have agreed that the requirement is unreasonable (stupid, ridiculous and ludicrous are other words that come to mind) and advised the person concerned to log on to relevant website (**www.eso.qld.gov.au**) and wade through what they must do. In some cases people have said that they could not understand the requirements on the website. Yes, I'm not surprised. The trouble with these people is that they think it might be logical and sensible – it isn't and nor is the language and presentation of the website.

I have also advised every caller to contact their local Member of Parliament and make their feelings known in the strongest possible fashion. That is what they should have done some time ago when we were campaigning for the right of everyone to do their own electrical wiring and related issues.

Interestingly, on January 8th, the Brisbane "Courier Mail" ran a story stating that only 11 of an estimated 1000 repairs has applied for the licence, in spite of the new regime taking effect on 1st February 2003. A spokeswoman for Industrial Relations Minister Gordon Nuttall said that "the Government had done all it could do to alert repairers to the new licensing requirements". Yeah, yeah. Funny that they did not take out any adverts in SILICON CHIP or other relevant magazines.

No, whether you are a repairer or just a consumer, you should get onto your local member of parliament and tell him or her that the situation is ridiculous. Furthermore, tell them that if the Electrical Safety Office was really interested in safety, they would not require electronics repairers to take out an irrelevant licence. At this stage the politician might be wanting an intelligent alternative. You can give them this:

If the ESO is really concerned about the safety of repaired electrical and electronic appliances, why don't they require that a standard safety check be done and each appliance be fitted with a sticker to say it has passed. The safety test could include physical and electrical checks of the power cord, insulation resistance and so on. Wouldn't that make more sense? The relevant portion of the Electrical Safety Act should immediately be suspended, repealed or otherwise nullified, to allow some commonsense to be brought to bear. But again, I'm not hopeful.

Leo Simpson

Special note: due to a printing problem, many readers in Western Australia have had difficulty obtaining a fault-free December 2002 issue. We arranged for the issue to be reprinted and sent to WA but evidently many readers were still unable to get copies from newsagents. To help those readers, we can supply the December 2002 issue for $6.60, including postage, until the end of March 2003.

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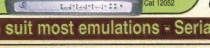

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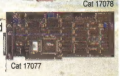

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MAILBAG

Active 3-Way Crossover project acknowledgement

Thanks for the presentation of my Active 3-Way Crossover in the January 2003 edition. However, I neglected to acknowledge that much of the design configuration came from Rod Elliot's website, and in particular, the configuration for feeding the LPF stage from the low-pass section of the midrange stages.

Rod's site has a wealth of information on all kinds of audio and other projects. It can be found at **http://sound.westhost.com**

Mick Gergos,
via email.

TV repairers may cause lethal appliance faults

Your Publisher's Letter in the January 2003 issue appears to have missed the point regarding TV and appliance repairers needing to have an electrical contractor's license. Your negative view begs the question, "Do you have an electrician's license?" Because if you did you would well understand the bureaucrats' and unions' viewpoint.

Imagine your appliance or TV being repaired by someone unlicensed: a fault may be created or develops after the repair. This places you or your family at risk. An accident occurs and someone is injured. You sue for compensation and the repairer claims on his insurance. The insurance company asks if the repairer is a licensed contractor and receives the reply "No". Where do you stand? Do you sue the repairer (who has no effective insurance) and send him bankrupt? Would you sue the bureaucrat for allowing the repairer to operate without a contractors license?

Perhaps the government in their wisdom have set a benchmark where all involved will be protected, both the repairer and the consumer. If the electronic or electrical repairer is so highly skilled why would it be difficult to obtain an electrical contractor's license that only mere electricians can possess.

You may also try to fathom the attitude of the manufactures in making throw-away appliances. Perhaps it is far better the appliance or device be discarded than be repaired when the original manufacturer has no control over who does the repair, regardless if it is in or out of warranty. Would the manufacturer be prepared to wear litigation because of faulty workmanship or inferior parts used by any repairer?

In regard to your comments about persons knowing the "true situation", please do not make remarks that will leave your readers assuming this is fact without qualification. Not all accidents or injuries are the direct result of electrocution. Many accidents and injuries can be from indirect means but attributed to electrical faults.

Paul Betteridge,
Port Macquarie, NSW.

Comment: believe us, the bureaucrats have set the "benchmark" too high. Few servicemen will be able to meet the requirements for the electrical contractor's licence. The only real way to do it is to do a course lasting several years.

We will go out on a limb and state that there probably never has been a fatality because of an appliance wiring fault caused by a repairer. In fact, we challenge anyone to come up with such a case.

Improving the damping factor of the SC480 module

I refer to page 26 of the January 2003 issue of SILICON CHIP. In the list of performance figures for the SC480 amplifier, you give the damping factor without the PTC thermistor. A small design change may be worth trying. It involves taking the majority of the negative feedback from the speaker side of the PTC.

Obviously, there would be problems if the present 22kΩ feedback resistor was connected to this position and a fault occurred. However, an improvement in the performance of the amplifier may well result with the following changes:

(1) For the present 22kΩ feedback resistor, substitute a higher value such as to bring the gain down to a controllable level with no load connected.

(2) From the base of the BC557 to the speaker side of the PTC, connect another resistor of value such that (1) & (2) in parallel present 22kΩ.

I note in the introduction you say "It also sounds much better". I would have thought, in amplifiers of this order, there would be no observable "sound" or "coloration" contributed by the amplifier when used in conjunction with other parts of an audio system.

Maurie Findlay, MIEAust,
via email.

Comment: it is true that you could improve the damping factor by taking a portion of the feedback from the output side of the thermistor. However, it could cause further problems in the event of a fault condition which operated the PTC; the resulting voltage gain in the unloaded amplifier would be much higher.

As far as the comment about sound quality is concerned, we can assure you that the SC480 definitely does sound a lot better than the ETI480.

CDs programmed to deteriorate

In your response to John Tingle and his letter concerning CD deterioration in the January 2003 issue, you say "the heat does it." Well, he keeps his collection in a "cool, dry room".

The real culprit is the chemicals still present in both the packing materials and the environment. Chemicals known as "plasticisers" are added to plastic materials to make them flexible and easier to process. Over time this leaches out and can attack other nearby plastics.

The foaming agents used to produce foamed plastics and rubber can also be destructive and corrosive. In addition, trace elements in the environment will cause long-term deterioration of plastics, especially foams. Ozone is one of the most destructive elements.

The problem of protecting valuable assets is a major concern to libraries, museums and archives. There are long-life, non-corrosive packing and filing materials available from specialist archival materials suppliers. Otherwise, advice can be sought from National Archives because they have to deal with the problem all the time and have produced guides to safer storage of archives. Check them out at:

www.naa.gov.au/recordkeeping/

On a related point, the politicians are keen to get on the "we are green" bandwagon and want to force biodegradable plastics into the market. So, how do manufacturers comply? By making plastic packing that contains chemicals that cause it to break down.

The pollies can beat their breasts because they have done something "good" for the environment. Of course, nobody thought about what would happen to the precious goods packed within this smorgasbord of chemicals or that the products of decomposition might be worse than the original plastics!

Colin MacKinnon,
via email.

Geostationary satellites do not fall to Earth

I have a few corrections to the article on satellite TV reception in the December 2002 issue of SILICON CHIP. Geostationary satellites do not fall to Earth once they have run out of fuel. They are far enough out that they are beyond the slowing effect of the Earth's atmosphere. The fuel they burn occasionally is to keep them "on station" at the correct position.

When they run out of fuel, they start drifting into a wobbling orbit, pulled by the gravity of the Moon and Sun. It would take a great amount of resistance, or a great amount of fuel (neither of which they have) to slow them enough to bring them down. They can effectively be considered permanent artificial satellites. Eventually the Clarke belt will have so many birds up there, that the chances of old ones bumping into active ones will increase. Fortunately, they are far enough out that there is a lot of space between them.

From the animation at the site mentioned below, you will see that there are many 'retired' geostationary satellites in wandering orbits near the tight ring of satellites that are 'on station'. Some of these are actually at slightly higher and faster orbits than the geostationary orbit. It probably depends on which way they were nudged by a last fuel burn but most are still at the same height, just wobbling.

GPS satellites are not low-earth orbiting satellites. They orbit at around 20,000km (about half the geostationary height) and have an orbital period of 12 hours. Also, some weather satellites (usually the ones used for 'satellite photos') are geostationary, while others are low-earth orbiting, depending on their particular role.

Low-earth orbiting satellites have altitudes between 300km and 1000km, with orbital periods of 1.5-2 hours. These are low enough that they are significantly affected by the Earth's atmosphere, so they will eventually fall back to Earth.

For an interesting exploration of many of the satellites out there, where they are, and the way they behave, check out:

http://liftoff.msfc.nasa.gov/RealTime/JTrack/3d/JTrack3D.html

Noel Bachelor,
via email.

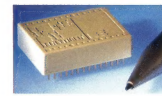
Publisher's letters are not so bad

It's not often that my normal state of torpor is disturbed by a letter to the editor but I cannot allow to pass the strange comments penned by Doug Thwaites in the December 2002 issue of SILICON CHIP.

The extraordinary suggestion that one should, by right, enjoy the whole of any magazine (or any other composite production, for that matter) cannot surely be made by anyone living in the real world. There are heaps of things which we can truly enjoy but there are always other things which will not be so acceptable.

So far as the Publisher's Letters are

The Tiger comes to Australia



The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multi-tasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

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concerned, I don't believe that there has ever been a bad one and I think anyone who has the temerity to suggest this would need to have a pretty good command of his subject. I must say that I have not infrequently disagreed with the argument but the Publisher's Letters are always well reasoned and well expressed.

Anyone who believes the world overall was a better place 30 years ago has suppressed the bad memories and exalted the good. Things are a lot more complicated now but I still have hopes that human beings may one day become civilised if we or nature doesn't destroy us first!

Probably, Doug Thwaites would get more of the sort of information he wants by searching the web. I doubt if there would be enough interest even to support a department in SILICON CHIP to suit Doug Thwaites or G. J. Wilson, let alone support a magazine.

In my view, Leo Simpson and the staff of SILICON CHIP are doing an excellent job and I will continue to subscribe so long as both the magazine and I are extant.

Alan March,
Turramurra. NSW.

CRT video monitors not obsolete yet

I would like to make a few comments regarding your December editorial about CRT video monitors. First of all, I don't think LCDs are the complete answer yet, although they certainly have their advantages. We use a mixture of LCD and CRT monitors at work and for straight picture quality, the CRT units win hands down every time.

I don't think your statement "CRT monitors have not drastically reduced in price" is really correct. Defying inflation, the ticket price of computer monitors has steadily declined over the past decade, while the quality of the actual CRTs fitted has increased enormously.

Of course, the same applies to ordinary TV sets. Just yesterday, I saw excellent quality 67cm "true flat" screen TVs in my local Aldi store for $699! A bit bulky, true, but compare that with the price of a plasma display! Incidentally, whatever happened to the 16 x 9 CRT "revolution"?

However, what I mainly wanted to point out is that everybody seems to be overlooking what will almost certainly be the dominant display technology of the future: Light Emitting Polymer (LEP) displays. There are already laboratory prototypes of completely flexible full-colour displays and it can only be a matter of time before this becomes the dominant technology.

Not only does it combine the thinness of LCDs with the picture quality of CRTs, it also holds the promise of allowing the manufacture of cheap and practical wall-sized displays for the first time.

The biggest problem at the moment is the relatively short life of the polymers but this is being improved all the time, to the point where they are beginning to appear in mobile phone screens, where the short operational lifetime is less of a consideration.

Adrian Kerwitz,
via email.

Publisher's letter should be broad ranging

I do not think you should restrict your editorials to just matters electronic. Industry and politicians always need stirring up, even if they usually still go off and do what they were always going to do in the first place.

Oh, and I do not think you need to cover the radio world. I think your appeal lies with the broad base of people who want to know and understand a bit about everything, especially if it borders on the edge of their understanding or knowledge at the time. Most radio people I know are dedicated specialists who are very tunnel-visioned.

Michael Hill,
Heathridge, WA.

Leaky motherboard capacitors

I writing to you to bring the topic of leaky and exploding capacitors to the attention of fellow readers. I work in the computer service industry and have come across, just recently, an increase in motherboard failures due to leaky or exploding capacitors.

Doing a search through the "Google" search engine for "Leaky Capacitor Motherboard" will list a couple of forums and websites dedicated to this subject.

According to these websites, it is not a isolated problem. It is across all brands and makes of motherboards. But I have only ever seen it in motherboards with late-model Pentium II CPUs and later.

If the problem can be addressed in time, the replacement of the offending capacitors with higher ratings is usually a cure but in all cases I have come across, the problem has not been discovered early enough. The capacitors and other components, usually the regulators around the CPU, have failed as a follow-on effect.

These regulators fail in a big way. All the boards I have seen have had the copper tracks severely discoloured and lifting. Also the PC board was charred from excessive heat. I have had a couple that have actually melted the solder holding them to the PC board.

What prompted me to write was the mention in "The Serviceman's" notes, December 2002 issue, about a JNL Digivision TV that was only two years old and had exploded capacitors in the power supply. I thought this could be a similar thing.

Mark Robin,
via email.

Comment: it appears that designers of switchmode supplies in many recent model video monitors and domestic TV sets are pushing the technology too hard. As a result, many recent model TVs and monitors are not as reliable as previous models. Apparently, the same applies to PC motherboard as well.

Macro viewer is a vision boon

I thought some readers might like to see an idea that grew from your Video Microscope project published in the October 2001 issue.

This macro viewer was built for my mother-in-law, who is suffering from macular degeneration, which almost robbed her of most all her reading

ability. The viewer has proved to be a lifeline for her. I have constructed two units, one for Sydney and one for her home in Taree which is set up at a permanent reading station.

With a 50mm lens, a multiplication of about 4:1 displayed on the monitor seems to be optimum for close reading on the screen. While similar commercial devices are available at upwards of A$2500, these cost in the order of about $150.

My thanks to SILICON CHIP for the basic idea, plans and inspiration.

Chris Williams,
via email.

De-glitching the EPROM programmer

I wonder if I might make a few constructive comments about your EPROM Programmer project without appearing to be excessively negative? Over the years, the various electronic hobby magazines have published many innovative projects but also numerous circuits which feature "de-glitching" filters to ensure "correct" operation.

All logic chips, with the exception of ripple counters, are designed to interact without suffering from "decoding glitches". If this were not the case, then products as complex as computers would never work at any speed, let alone at the mind-boggling speeds we presently see.

Intuitive design methods can readily make one of anything work but when large numbers of identical products are required without individual adjustment, a rather more rigorous design discipline is necessary. For example, the 74HC138 (1-of-8 decoder) you use as an address decoder, really requires a control strobe signal on the enable lines to conform to its intended use.

Your design has used up all the available output signals and seems to have no other choice but in fact it is easy to free up several lines by simply using edge-triggered latches (74HC-374) instead of level-triggered latches. Simply use those inverters (IC5) to clock one set of data in on the falling edge and another on the rising edge.

You already have the required inverters in your circuit. The trigger PGM pulse can now be connected to the free select line from the 74HC138 and the printer strobe signal on pin 1 of CON1 can be used to strobe pins 4 & 5 of the 74HC138 as intended by the manufacturers.

The glitch filters are then no longer needed as software generates the strobe while the address is steady.

Similarly, in the Program pulse length timer, the 74HC161 can be used much more elegantly to avoid the "glitch" problem you refer to. Where possible, it is best to avoid level-triggered flipflops (IC4a & IC4b) in favour of edge-triggered units, as these give you more choice as to when you wish the output state to be read.

In this case, simply clocking the IC13 terminal count into a "D" flipflop (such as 74HC74) with inverted clock gives clean glitch-free operation. If the program pulse is started with the clear line, then an extra half cycle is added to its duration but this is probably of little consequence in this application.

Using the 74HC74 as a divide-by-2 can be dangerous and unpredictable. This is because when the clock reads in the data on the "D" input, it is actually possible that the input changes state before the hold time expires. Happily, the HC logic family have extremely short hold times and will generally operate this way, however it is a close call and one with a less favourable outcome when TTL or LSTTL are involved. Using J-K flipflops for dividing is a better proposition, being free from such "race" conditions.

HC family chip manufacturers recommend that any chip with inputs derived off the immediate circuit board have a pull-up resistor of typically 47kΩ to 100kΩ at the connector and then a 10kΩ series resistor mounted very close to the IC input pins. If "bus termination" properties are required, then individual RC terminators can be used at the board connector as well.

If the inputs are left open circuit as in your design, then the inputs can readily assume any voltage as they represent an extremely high impedance. They can easily assume a voltage of 2.5V and drive both output FETs on and cause cross conduction and overheating. Open-circuit inputs are also rather more vulnerable to ESD damage.

In general, CMOS and HCMOS inputs should never be exposed to an open circuit. At the high end of the speed scale it may be necessary to reduce the 10kΩ series resistor.

In EPROM Programmers I have designed, I have always put a resistor in series with each data pin to cover the case when someone puts in an EPROM back-to-front. This error can allow the Vpp supply to punch through a data pin and find its way into the programmer circuits and possibly right through to your printer card or even motherboard! The HC ends of these resistors are individually clamped to a 4.7V zener diode. Naturally the Vcc and Vpp pins have no resistor but do have a current-limited power supply.

I hope you can accept these observations in the spirit that they are offered. I spend quite a deal of my time solving problems for other people. Simple issues like those outlined above are all too often the cause.

I wonder if there might be any interest in an article on logic design methods by a professional electronic design engineer? If so I would be willing to put some material together.

In any event, keep up the good work, there's a lot of people out here relying on you as the last real electronics magazine.

Graham Lill,
via email.

Comment: thanks for the feedback. Readers are also referred to the comments about pullup resistors in the third article on the EPROM Programmer in this issue. **SC**

PICAXE – the new millennium 555?

Stan (the man) Swan, electronics lecturer from Massey University in Wellington (NZ), leads the charge with the innovative PICAXE-08, the PIC for everyman. Stan reckons this PIC is really easy to use, even for old-timers!

The legendary electronic industry workhorse IC, the 8-pin 555 timer, was first introduced (unpatented!) by Signetics in 1972.

It subsequently featured in countless circuits. Virtually every monthly electronics magazine (SILICON CHIP included) continues to have further tips, hints and innovative tweaks for them. In fact, entire "555 Cook Books" have evolved.

In today's silicon chip age, the 30-year endurance of such a humble device is a remarkable tribute to its sound initial design, reliability and cheapness.

It's been the largest volume IC sold every year and the original design, although enhanced with lower powered CMOS versions, remains unmodified.

To put this in historical context, consider that the 555 dates from the first pocket calculators, VCRs and colour TV sets, and that today's 21st century electronic appliances (DVDs, mobile phones, home PCs, GPS, etc) were then the stuff of science fiction.

Given its white-hot rate of change, thirty years in electronics compares to perhaps three hundred in normal engineering fields (steam engines to space shuttles?) and by any measure the 555 seems due for a successor.

Enter the PIC

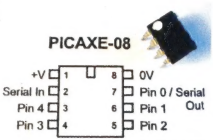
The 1990s arrival of the Microchip PICs (Peripheral Interface Controllers or Programmable ICs), with their PC interfacing, cheapness and non-volatile RAM, initially showed most promise.

PICs abound in modern electronic devices, including bread makers, washing machines, sewing machines, PCs, mobile phones, digital cameras and even toys.

Most PICs now are Flash RAM, with the "F" (rather than an earlier "C"), indicating block memory cell erasure when electrons pierce a thin dielectric under Fowler-Nordheim tunnelling.

Phew! Data remains in the IC without any battery backup, yet can be easily be edited or retrieved.

An irksome trade-off between cost and programming difficulties exists however. Bare PICs (such as the popular PIC16F84) are cheap and powerful but too complicated for many enthusiasts and educators.



Although both the 555 and PICAXE are 8-pin DIP, their internals differ radically. Note that the "I/O pin" numbers are NOT the same as the chip "leg" numbers (especially 3 & 4!).

They may be great for controlling smart washing machines and ideal for mass production but they intimidate beginners simply wanting to flash a few LEDs!

In contrast, the Parallax BASIC "Stamp" variations were better suited to education and developmental work, since they were easy to high-level program in BASIC.

But their costs were usually much too high to justify production work and their large footprint was – well – postage-stamp sized.

More recently, high level editors

Part 1: Introduction to the PICAXE – by Stan Swan*

It's a PIC that even your dog could understand. . .

and PIC intro kits have also abounded but with costs or assembly complexity still rather daunting for newcomers.

Lo, the PIXAXE!

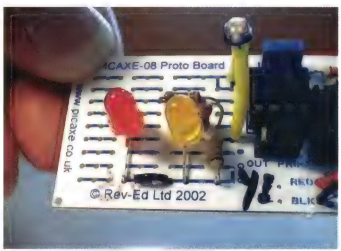
In an admirable blend of industry and education, akin perhaps to Victorian ventures when schools aligned with local firms, the UK Oil and Gas Industry recently funded a West Country firm, Revolution Education, in a remarkable PIC venture.

The firm already handles a more powerful and larger PICAXE "18" and "28" range but it's their new 8-pin PICAXE-08 that looks set to take the "555 successor" mantle.

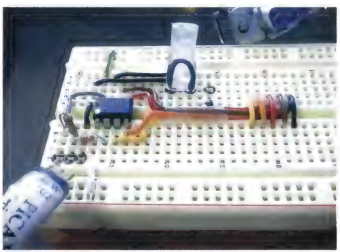
PICAXE-08s are bubble-gum cheap, powerful, have non-volatile memory and are delightfully easy to use.

They PC-connect via a 3-wire D9 serial cable and program under a free Windows high level editor using 35 BASIC "plain English" commands such as "high, low, nap, goto, sound, if...then, sleep" etc. Even your dog could understand these!

The command set is intentionally similar to that of BASIC "Stamps", meaning that circuits and code already



The Revolution Education Starter Pack board uses soldered contacts and although allowing neat assembly, can be heat damaged and is inconvenient for prototyping. A suggested layout on 300-hole protoboard is shown at right – much more convenient for the hobbyist and experimenter.



The PICAXE-08 has unusual supply voltage positions: Pin 1 is +ve and pin 8 is ground. The jumper allows one channel to be used for I/O as well as normal programming. Wire colours follow normal resistor colour coding to help identify channels, ie, black 0, brown 1, red 2, orange 3, yellow 4.

PICAXE-08 COMMANDS (Note similarity to Parallax BASIC Stamp PBASIC)

Several "pseudo" commands too, especially **SYMBOL** (assigns new World to a value) and **INPUT** + pin. **Rem** statements (') or 'goodbyes (') precede remarks/comments. & also rooms (') as usual in BASIC.

DIGITAL OUTPUT.

HIGH Switch an output pin high (on).
Example: ***High 2*** *turns pin 2 on.*

LOW Switch an output pin low (off).
Example: ***Low 3*** *turns pin 3 off.*

TOGGLE Toggle (alter) the hi/lo state of an output pin.

OUTPUT Set a pin as an output.
Example: ***Output 1*** *makes pin 1 an output.*

INPUT Set a pin as an input.

REVERSE Reverse the I/O state of a pin.

PULSOUT Output a timed pin inverted pulse.
Example: ***Pulsout 0,3*** *- pin 0, 30 microseconds.*

ANALOG OUTPUT

PWM Provide a pulse width modulation output.
Example: ***Pwm 1,20,8*** *- pin 1,20/255 duty, 8 cycles.*

SOUND Make sound(s) 0 = quiet, 255 = hiss.
Example: ***Sound 4,(100,10)*** *- sound pin 4,~5kHz,~100ms.*

DIGITAL INPUT

IF...THEN Jump to new program line, depending on condition.
Example: ***If b3 < b2 then ledoff***

PULSIN Measure input pulse duration (µs).
Example: ***Pulsin 4,0,w2*** *- pin 4 input, logic low triggered.*

ANALOG INPUT

READADC Read analog channel (0 - 160) into a variable.
Example: ***Read 1,b2*** *- read channel 1 into b2*

PROGRAM FLOW

FOR...NEXT Establish a for-next loop.
Example: ***For b2=0 to 100 step 2*** *- counts even numbers.*

BRANCH Jump to address specified by output if in range (akin to ON x GOTO).

GOTO Jump to address.
Example: ***If b0=5 goto daylight*** *- goes to daylight routine if b0=5.*

GOSUB Jump to subroutine at address specified.
Example: ***Gosub test*** *heads to test subroutine.*

RETURN Returns to main program from gosub routine.

VARIABLE MANIPULATION

(LET) Assigns a value to a variable & does limited L-R maths.
Example: ***Let w0=b2*22/7 – Pi***

LOOKUP Lookup indexed data specified by offset & store.
Example: ***lookup 1,(6,7,8)*** *- takes 7*

LOOKDOWN Search values for a target's match number & store in variable, akin to $trings

RANDOM Generate a pseudo-random number.

SERIAL I/O

SEROUT Serial data output (to 2400bps).
Example: ***Serout 0,n2400,(65)*** *- sends ASCII 65 (=A).*

SERIN Serial data input - many qualifiers!
Example: ***Serin 0,n2400,("A")*** *- waits for ASCII 65.*

INTERNAL EEPROM ACCESS (program & data storage; take care since program overwriting may occur).

EEPROM Store data in EEPROM before download.
Example: ***eeprom 0,("hello")*** - starts @ location 0.

READ Read data EEPROM into variable.
Example: ***Read 255,b2*** *- get location of last program instruction.*

WRITE Write variable into data EEPROM.
Example: ***Write 220,b3*** *- stores byte b3 into address 220.*

POWER DOWN

NAP Enter low power 20µA mode for short period (<2.3 secs).
Example: ***Nap 3*** *- sleeps for 144ms.*

SLEEP Enter low power mode long period (±1%).
Example: ***Sleep 3600*** *- sleeps for 1 hr (max 65535s).*

END Power down until reset (indefinite sleep).

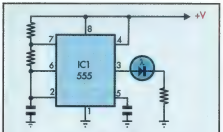
MISCELLANEOUS

PAUSE Wait up to 65535ms (65.5) ~ 1ms overhead.
Example: ***Pause 100*** *- pauses ~100ms = 0.1s.*

WAIT Wait for up to 65 seconds.

DEBUG Displays variable value on attached PC screen.
Example: ***Debug b0*** *- shows b0 value on screen.*

Ch.0 PROGR or switchable OUT
Ch. 3 IN only
Ch.1 Low res. Analog I/O



A typical 555 oscillator circuit to flash a single LED. As you can see, even this simple circuit requires more components than the PICAXE. And that's all this circuit can do!

produced may readily convert to PICAXE use. PICAXE-08s are based on the new Microchip 8-pin PIC12-F629s but with the BASIC interpreter squeezed on-board.

Such interpreters allow easy code tweaking, since the program doesn't need compiling before each run, although a slight execution overhead (about one millisecond) exists.

They have in-built 4MHz oscillators, 1K code space, 64 bytes RAM, 128 bytes EEPROM (enough for about 40 lines of code), five I/O pins and valuable low-resolution analog-to-digital conversion (ADC).

Battery needs are a flexible – 2.5V to 6V at just 2mA, yet they're able to supply 20mA at each pin to drive LEDs or piezo speakers, etc.

Perhaps the PICAXE name represents a miner's digging tool with "Silicon – I've struck Silicon!" the cry, instead of "Gold!"

Gold prices are irrelevant however, since PIXAXE08s sell for an astoundingly low $3 each. Being so cheap, they can be even left in the final soldered circuit.

On the left is the classic 555 oscillator, very cheap but with all aspects hardware-dependent. Contrast this with larger footprint and much more costly BASIC "Stamp" approach at right. In the centre is the smaller PICAXE approach which offers the best of both worlds: software control and "bubble gum" cheapness.

Later software tweaking can be attended to with a 3-wire serial connection if need be.

It's recommended that all PICAXE circuits have such a simple inclusion and the associated 10kΩ and 22kΩ resistor pair.

Folks, if you've been meaning to get into PICs but thought the process akin to unravelling DNA sequences, then PICAXE chips are the answer.

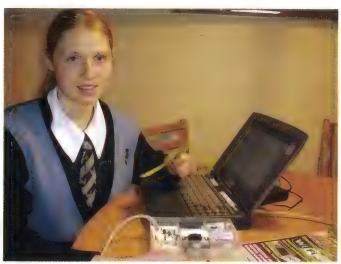
Although Revolution Education (UK) market a $25 "Starter Pack" (along with other project boards) that could be ideal for dedicated circuits, this involves fine soldering and inconvenience when away from the workbench.

For more flexibility, solderless protoboards are better, since these allow easy component swapping and reuse, neater circuit layouts, and no burnt fingers!

It's a PICNIK!

With increased productivity in mind, I've developed the PICNIK (Peripheral Interface Controller Nifty Intro Kit?) box.

Introducing the PICNIK box – the "Peripheral Interface Controller Nifty Intro Kit." The protoboard fits neatly into a parts box and along with the battery pack and sundry other components, offers a one-stop PICAXE experimenter's kit.



Emily, a Year 11 student, uses her notebook PC and a PICNIK to create an instant solderless PIC workshop. It's suitable for education, non-specialist workrooms or home use.

What are the goodies in the PICNIK Box . . .

PICAXE-08 IC	Revolution Education, UK (see website) Approx. $3 each in a tube of 5
Small solderless "Wish" protoboard	Sold by most electronics outlets.
4 AA battery holder and battery snaps	Ensure PICAXE is not run from 9V!
4 AA cells	(Power demands are very light, so cheap non-alkalines should do).
Solid core hookup wire	Multi-coloured (avoid stranded wire on protoboards).
Wire snips & strippers	Even fingernail nippers can be used!
Small piezo speaker	Allows direct sound production. (Don't use a normal 8Ω speaker).
Assorted LEDs	Easily driven by the PICAXE.
330Ω dropping resistors	LEDs can be driven directly but it's wise to use these.
Light Dependent Resistor (LDR)	Allows easy ADC action via a simple voltage divider with further resistors.
3-wire serial cable	Perhaps from an old serial mouse and PC motherboard header pins.
Other tools & materials	Hot-melt glue gun, wide heatshrink tubing (clear), photocopied labels.
PICAXE Editor and .PDF manuals	from CD, or free download from Rev-Ed (also at **www.picaxe.orcon.net.nz**).

The protoboard neatly fits into a semi-transparent parts box and along with the battery pack and sundry other components, offers a one-stop PICAXE experimenter's kit.

Few of its items are exotic, and with junk box fossicking, the total bill of materials shouldn't set you back more than $30.

Both educational users and experienced circuit developers should find this a most cost effective approach.

We hope to use the PICNIK box over the next few months to get you as enthusiastic about these new chips as we are!

What's this? No serial port?

Don't have a serial port in that spiffy new notebook? The computer industry has perhaps been rather TOO keen to run with USB !

Although wonderfully convenient and well supported now by modern peripherals, USB-only machines leave serial RS-232 "legacy" devices in limbo – including our PICAXE.

This may also be frustrating for GPS, data logging and PDA applications.

Help is at hand, however, since USB to serial adaptors (but NOT vice versa) are available, althought they may be quirky and costly (A$60 range) and need software drivers.

Undemanding "3 wire" serial needs, such as this PICAXE-08 ,should be supported by almost any such adaptor but if conversion problems arise it's suggested you just rescue that older serial-port-fitted Win95 PC from the broom cupboard!

References and updated material

For convenience these are not linked at website http://picaxe.orcon.net.nz/refs.htm

http://picaxe.orcon.net.nz	Author's pictorial page outlining PICAXE-08 features
http://picaxe.orcon.net.nz/progedit	Free program editor and PDF manuals (6 .cab files ~ 8.5 MB)
www.hippy.freeserve.co.uk/picaxe.htm	Overview of entire PICAXE family
www.rev-ed.co.uk	Revolution Education, Bath UK, microcontroller products
www.picaxe.co.uk	Rev-Ed's PICAXE products and programming editor
www.techsupplies.co.uk	Rev-Ed's online technical products shop – global sales!
www.jpixton.dircon.co.uk/pic/history.html	PIC history page
www.microchip.com	Microchip PICmicro products and data.

Who is Stan Swan?

We first met Stan Swan in his "WiFi" article in SILICON CHIP back in November 2002.

Stan is a New Zealander who first wrangled electrons with 1960s valve-era ham radio. He is a career educator teaching Electronics and Computer Technology at the Wellington (NZ) campus of Massey University.

His enthusiasm for "hands on" appropriate technology covers such diverse fields as PC interfacing, alternative energy resources, wireless data comms, digital photography and Internet applications. He credits Ray Doty's "Wordless Workshop " and the lucid electronics articles of US writer Forrest M. Mims III as especially formative influences.

* Stan's email address is **s.t.swan@massey.ac.nz**

Your first PICAXE application: a simple LED flasher

The 555 timer oscillates under time periods established by external resistor and capacitor values.

If a LED is used at the output, perhaps on a battery-powered bike light, the flash rate, duty cycle and battery drain can be juggled by changing these components.

This may be very inconvenient, especially if only physically larger capacitors are available!

In contrast, a PICAXE LED flasher uses software tweaks for fine tuning. Flash rates that are the most attention-getting or duty cycles that prolong battery life are simply "cut and tried" at the PC keyboard.

Not only is this more versatile but the parts count, cost and circuit size are all reduced.

First attach the programming serial cable, connect a LED (plus suitable dropping resistor (see below) to output 2 and power up the PICAXE-08.

Run the editor (download free from www.rev-ed.co.uk or http://picaxe.orcon.net.nz) on the PC, enter the following code and send it to the PICAXE.

The comments (preceded by ') are not saved on the IC but are essential documentation for your future reference. Colons (:) identify the defined routine – helpful names are best.

```
ledflash:     'LED flash rate & mark/space
              experiment
high 2        'turn on output pin 2 – LED lights up
pause 5       'keep it on for 5 milliseconds
low 2         'turn off pin 2 – LED goes out
pause 50      'keep it off for 50ms
goto ledflash 'repeat routine
```

The value of R_D, the series resistor, depends on the supply voltage and the type of LED you are using. In fact, it may not even be required as there is a 20mA limit on the PICAXE output.

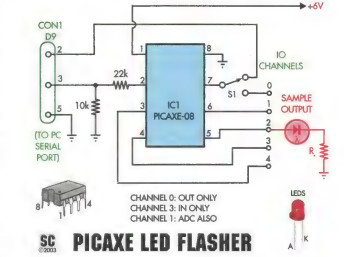
But we are used to using current-limiting resistors with LEDs so let's keep it that way and avoid accidents!

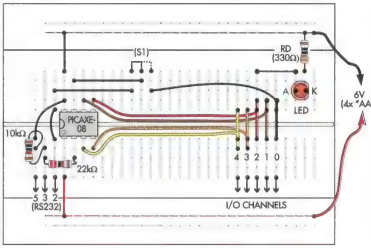
For a red LED (which requires about 2V @ 10mA), with a 6V supply, R_D = (6-2)/.01, or 400Ω (330Ω would be fine).

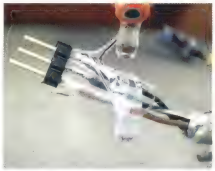
For a white LED (3.6V @ 25mA), R_D = (6-3.6)/0.025 = 100Ω.

With an ultra-bright white LED, normally taking 25mA at 3.6V, this 10:1 duty cycle pulsing still gave the impression of a steady light, yet average current dropped to just a few mA.

This means batteries should last 10 times as long. The inbuilt slight interpreter overhead could mean the timing is stretched by a millisecond or so.







DIY serial leads can be made using header pins rescued from old motherboards or modems. First, solder the three serial wires, then dribble hot-melt glue onto them. Allow this to cool somewhat and while still warm and pliable, work it with your fingers into a neat "plug".

The D9 serial plug has its pins 5, 3 & 2 going to PICAXE legs 8 [ground], 2 (via a 22kΩ resistor) [serial in] and 7 via a jumper (S1) [serial out]. A small photocopied label slid under protective clear heat-shrink tubing will identify the plug after final hot-air shrinking.

NEXT MONTH: A more ambitious application of the PICNIK box. Build your solderless kit up now and get to know its features in anticipation!

FEATURE PROJECT

The PortaPAL

A State-of-the-art Portable Public Address Amplifier

Features

- Portable, 12V battery-powered unit with safe plugpack charger
- High power output
- Inbuilt 200mm (8") loudspeaker with tweeter
- 2 combined XLR/ 6.35mm microphone inputs plus 6.35mm guitar or aux input
- Stereo RCA line inputs with stereo to mono mixer
- 2 line outputs with stereo RCA and 6.35mm jack outlets
- Level control for each input
- Bass and Treble controls
- Automatic power-down to extend battery charge with power-down indication
- Charger on and charging indication
- Storage space for spare leads
- Box includes carry handle, speaker stand socket and corner protectors

This portable PA amplifier can be powered from the 240VAC mains or its inbuilt 12V SLA battery. It delivers up to 70 watts and pulls a number of tricks to keep battery current low while still maintaining very high performance.

Back in March 2002 we published the "Mighty Midget", a 70-watt class-H audio amplifier module based on the Philips TDA1562Q power IC.

This ground-breaking IC uses special techniques to deliver up to 70 watts from a 12V battery and does away with the need for a DC-DC inverter.

At the time, we said the "Mighty Midget" was ideal for use in a portable PA system and now we have followed up with the PortaPAL: a complete system, including mixing for two 600Ω balanced or unbalanced microphones, guitar input and line inputs for a CD player or a cassette deck.

This new circuit makes use of the TDA1562Q's muting feature, to further reduce battery drain and keep hum and noise very low.

We've also taken advantage of the inbuilt 12V SLA (sealed lead acid) battery to eliminate a heavy transformer and large and expensive electrolytic filter capacitors from the power supply – leading to a considerable cost saving.

No DC-DC inverter needed

Up until the release of the Philips TDA1562Q IC, if you wanted more than about 16 watts from a 12V-powered PA system, you had to resort to a DC-DC inverter to provide power supply rails of, say, ±40V, to get around 50 watts into an 8-ohm load.

Not only are DC-DC inverters relatively complex but even the most efficient designs inevitably lead to a reduction in overall circuit efficiency.

With its special class-H operation and bridged amplifier operation, the TDA1562Q not only eliminates the need for an inverter but its class-H operation is considerably more efficient than a normal class-B amplifier which is what would be normally used.

So enough of the rave about the TDA1562Q – if you want more info, refer to the March 2002 issue of SILICON CHIP. Now let us have a look at the other features of this great little (actually, not so little) portable PA amplifier.

PART 1: BY JOHN CLARKE & LEO SIMPSON

Features

Housed in a timber cabinet measuring 450 x 280 x 240mm, the PortaPAL amplifier uses a coaxial 200mm speaker which is rated at 50W and has relatively high efficiency of 92dB/1 watt @ 1 metre. It is a 4Ω speaker which incorporates a separate concentrically mounted miniature dome tweeter; that's where the "coaxial" term comes from. The speaker is specified as a 4Ω model because the amplifier is designed to deliver maximum power into a 4Ω load.

All the controls are at the rear of the cabinet. There are two XLR sockets for connection of low impedance (600Ω) balanced microphones. These special XLR sockets also accept standard 6.5mm jack sockets so that unbalanced microphones can be used as well.

There is also a pair of RCA phono sockets for connection of a CD player or cassette deck and RCA sockets are also provided for line out signals to a cassette deck, if the proceedings need to be recorded, or to another PA system. This output is also duplicated at a 6.35mm stereo jack socket.

There are four mixing knobs for the microphones, guitar and line inputs but there is no master level control, to keep things simple. Bass and treble tone controls are provided and automatic VOX is built in.

PortaPAL Specifications

Output Power	33W RMS into 4Ω (depending on battery voltage)	
Music Power	70W RMS into 4Ω (depending on battery voltage)	
Frequency Response	Line	-3dB at 26Hz and 40kHz
	Guitar and microphone	-3dB at 42Hz and 20kHz
Tone Controls (see graphs)	+13dB and -14dB at 100Hz +11dB and -13dB at 10kHz	
Input Sensitivity: (for 30W into 4Ω)	Line	340mV RMS
	Guitar	16mV RMS (1.9V RMS overload)
	Microphone	1.3mV RMS (130mV RMS overload)
Signal-to-Noise Ratio: (all figures with respect to 33W)	-83dB unweighted (20Hz to 20kHz); input level controls all off -71dB unweighted with microphone level set at maximum sensitivity (-73dB A-weighted)	
Muting	Threshold:	<7mW output power
	Time:	15 seconds (typical) after signal drops below threshold 100ms (typical) unmute when signal applied
Battery Consumption	Standby (mute)	26mA
	No signal (unmute)	160mA
Battery Charger	Charge rate:	1A maximum
	Charge voltage:	13.8V maximum
Dimensions:	500 x 295 x 250mm (including handle and corners/feet)	
Mass	13kg (including charger plugpack)	

There are four LEDs on the panel, two at the top righthand corner and two lower down, adjacent to the pluppack charger input socket.

At the top, one of the LEDs flashes about twice a second to indicate that the unit is on while the other is the "Fault" indicator. We'll talk more about this and the charger LEDs later.

The only other control is the On/Off switch. Also on the rear panel is the lid for the 12V battery compartment and the battery can be quickly changed over if that is necessary. Power comes from the battery or an external 16VAC 1.5A plugpack.

While the plugpack has relatively low power rating (24VA) with respect to the maximum output of the PA amplifier, it is quite adequate to keep the battery fully charged in normal PA operation.

In fact, the power supply is really just a battery charger with the battery permanently connected.

The inbuilt VOX operates to mute the power amplifier if there is no signal for more than 15 seconds, reducing the standby battery consumption from 160mA to around 26mA.

While it is hard to be precise, we estimate that the inbuilt 12V 7Ah battery should be good for about five to six hours use. In practice, that means you could typically use the PortaPAL all day on battery power.

Circuit overview

Fig.1 shows the simplified block diagram. Apart from the TDA1562Q power amplifier IC, there are eight low-cost ICs and not a lot else. The microphone signals are amplified in op amps IC1a and IC1b, while the guitar signal is amplified by op amp IC3.

The microphone, guitar and line signals are set by potentiometers VR1, VR2, VR3 and VR4 and then mixed and fed to the tone control stages and to the muting circuit involving IC6 and D1 & D2. This circuit provides a mute signal to the power amplifier when the audio signal levels are below a certain threshold.

Circuit details

As already noted, the Portable PA uses two special XLR sockets which also accept stereo or mono 6.5mm jacks.

For simplicity, these sockets are shown on the circuit of Fig.2 as separate XLR and jack sockets but remember that they are combined into what look like ordinary 3-pin XLR sockets.

In normal operation, using a microphone with an XLR plug, the balanced microphone signals are fed to the inputs of op amps IC1a & IC1b. These provide a gain of 22 from a 600Ω microphone.

Both microphone preamps are identical except that the MIC1 preamp has provision for a bias voltage (phantom power) for electret microphones, if required.

The use of 1% resistors in the balanced microphone circuits ensures good rejection of common mode signals such as hum and hash.

High frequencies above 50kHz are rolled off by the 150pF capacitors across the 22kΩ feedback resistors. The 390pF capacitors shunting the balanced input lines, in conjunction with the microphone impedance, also

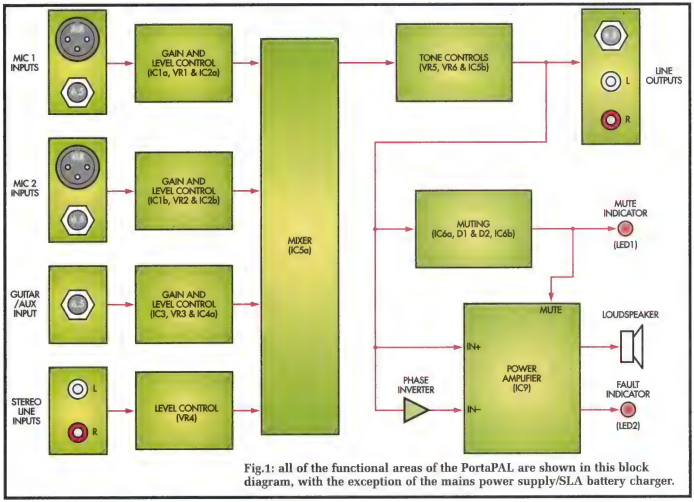


Fig.1: all of the functional areas of the PortaPAL are shown in this block diagram, with the exception of the mains power supply/SLA battery charger.

roll off the high frequencies.

Should you insert a 6.5mm stereo jack plug from a balanced mike into the XLR socket it will again be accepted as a balanced signal and converted to a single-ended output.

But here is the clever part. We have wired it so that if you insert a mono jack into the socket, the non-inverting input (pin 3 of the XLR) is grounded and IC1a (or IC1b) operates as a normal non-inverting amplifier with a gain of 22.

Thus we cater for both balanced and unbalanced low impedance microphones.

The unbalanced outputs of op amps IC1a & IC1b are each fed to level potentiometers VR1 & VR2 via a 150Ω resistor and 1µF capacitor. The signals from VR1 and VR2 are then applied to op amps IC2a and IC2b, both of which have a gain of 11. This means that maximum gain for microphone signals is 242.

Guitar input

The guitar input stage involving the TL071 Fet-input op amp IC3 looks like a straightforward non-inverting amplifier but there are a number of interesting wrinkles.

First, the guitar signal is coupled in via a relatively large value of capacitor, 47µF, especially when the input load resistor is also high at 470kΩ. This is because are aiming for two separate outcomes. We have specified the high load resistance of 470kΩ to ensure optimum high frequency response with the relatively high inductance of typical guitar pickups.

With such a high load resistance, you might wonder why we have used such a large input coupling capacitor. After all, to maintain a flat response to below 20Hz, all you need is a 15nF (0.15µF) input capacitor. Why use 47µF, 300 times bigger?

The answer is that the inductive guitar pickup represents a low source resistance at low frequencies. In order to minimise noise, op amp IC3 needs to see as low a source resistance as possible. Ergo, we use a big capacitor.

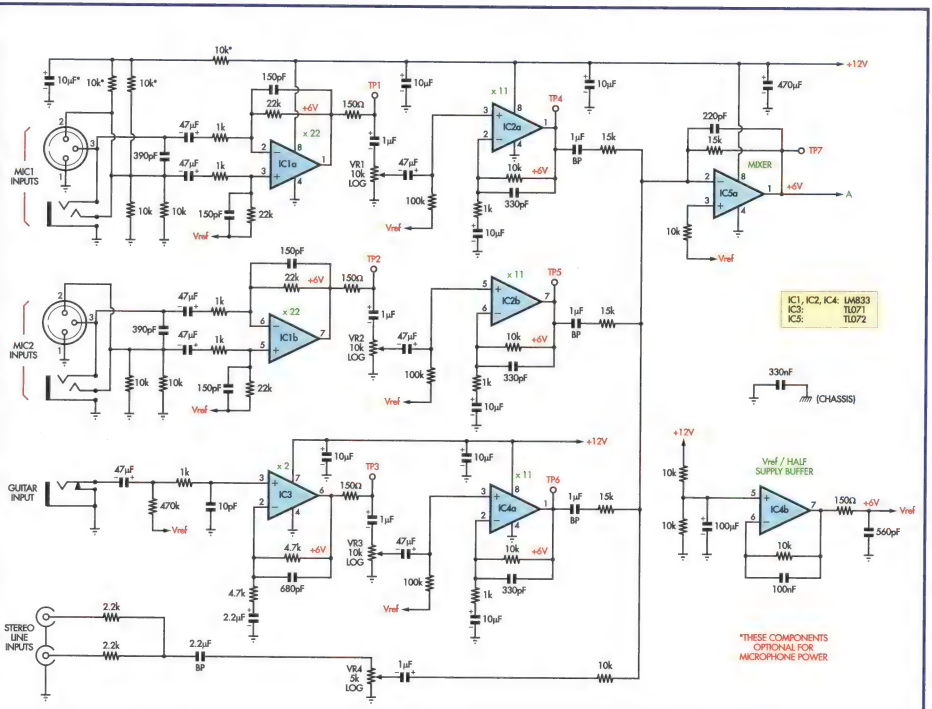
IC3 is set for a gain of just two. This is adequate for any guitar (when the following gain is accounted for) but it also means that this input can handle line input signals of up to 1.9V before overload occurs.

Following potentiometer VR3, the guitar signal is fed to op amp IC4a, which has identical gain to IC2a & IC2b.

Construction will be fully described next month but to whet your appetites, above we show the completed amplifier assembly ready for mounting in the box, while below is shown the separate SLA charger board. By the way, this could be built independently as a high performance SLA battery charger.

Stereo line inputs (eg, from a CD player) are mixed to a mono signal with 2.2kΩ resistors and fed to potentiometer VR4. All of the signals from the four potentiometers are then mixed in IC5a which has gain of unity. Note that the input resistor from VR4 is 10kΩ rather than 15kΩ to make up for a slight gain loss in the resistive mixing of the stereo line inputs.

IC5a drives the tone control stage involving IC5b and this has its output signal fed to three places: the line output to RCA and 6.35mm jack sockets, the muting stages involving IC6


MIC1 INPUTS
MIC2 INPUTS
GUITAR INPUT
STEREO LINE INPUTS
IC1a
IC1b
IC2a
IC2b
IC3
IC4a
IC4b
IC5a
MIXER
+12V
Vref
+6V
TP1
TP2
TP3
TP4
TP5
TP6
TP7
VR1 10k LOG
VR2 10k LOG
VR3 10k LOG
VR4 5k LOG
IC1, IC2, IC4: LM833
IC3: TL071
IC5: TL072
330nF
(CHASSIS)
Vref / HALF SUPPLY BUFFER
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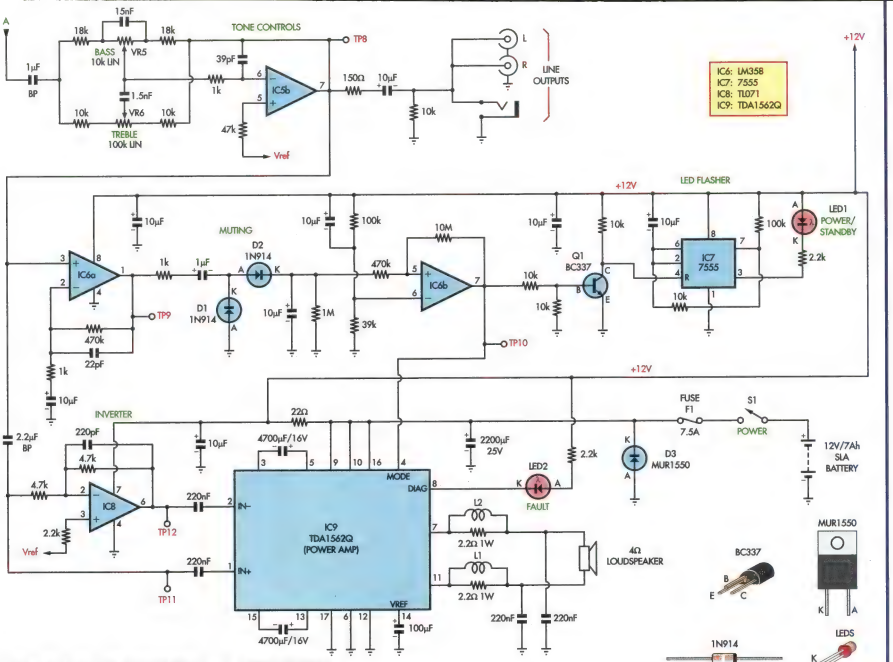
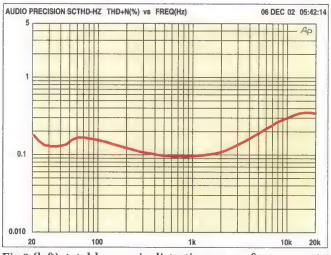


SC ©2003 "PORTAPAL" PORTABLE PA AMPLIFIER



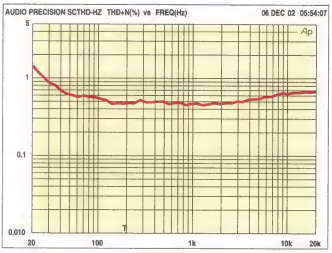


Fig.3 (left): total harmonic distortion versus frequency at 12W using the microphone input. Fig.4 (right): total harmonic distortion versus frequency at 30W using the microphone input.

and the power amplifier involving IC8 and IC9.

All of the op amps in the circuit, with the exception of IC4b and IC6, have their non-inverting (+) inputs biased from the V_{ref} line which is at +6V.

This is derived from the +12V line by a voltage divider consisting of two 10kΩ resistors with the centre point bypassed by a 100μF capacitor. The bypassed supply is then buffered by op amp IC4a to provide the V_{ref} line.

This means that all op amps will have symmetrical clipping at overload, to maximise the output signal. All op amp outputs, with the exception of IC6b, will sit at +6V (or half the battery voltage).

Muting stages

As noted above, we have incorporated VOX into the circuit to mute the amplifier and cut current consumption when no signal is present. This muting function is provided by dual op amp IC6. Op amp IC6a is a non-inverting stage with a gain of 471 by virtue of the 470kΩ and 1kΩ feedback resistors. The 22pF capacitor rolls the gain off above 15kHz, while the 10μF capacitor in series with the 1kΩ resistor rolls off signals below 16Hz.

The amplified signal from IC6a is then fed to a diode pump circuit consisting of diodes D1 & D2 and 1μF & 10μF capacitors. Hence, the peak level of the signal from IC6a will be stored in the 10μF capacitor which is continuously being discharged via the 1MΩ resistor across it.

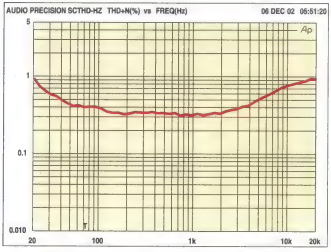
The 10μF capacitor is monitored by IC6b which is connected as a Schmitt trigger. A 10MΩ resistor between pin 5 and pin 7 applies a degree of positive feedback to give hysteresis. This makes the comparator output switch cleanly between high and low, to prevent the possibility of parasitic oscillation at the switching points.

The inverting input of IC6b is set at +3.4V using the 100kΩ and 39kΩ resistors across the 12V supply.

When power is first applied to the circuit, the 10μF capacitor between the 12V supply and the inverting input to IC6b is initially discharged and therefore pulls pin 6 high, causing pin 7 to be low.

Pin 7 of IC6b is connected to the mute (mode) input, pin 4, of the power amplifier, IC9. So at power-up, the amplifier is muted.

Once the audio signal monitored by IC6a is of sufficient level, IC6b's output will go high and the power amplifier will be unmuted.



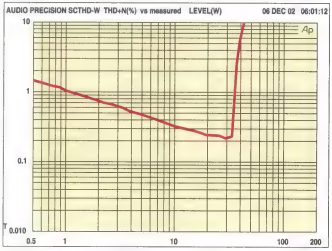


Fig.5 (left): distortion versus frequency at 30W but using the line input. Fig.6 (right): power versus distortion when driven by the microphone input. Maximum power here is 42W at 10% distortion but this will depend on battery charge.

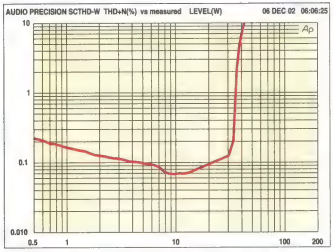


Fig.7: Power versus distortion when driven by the line input. The distortion is lower than Fig.6 because of the lower gain from the line input.

Muting indication is provided by IC7, a CMOS 7555 timer, which drives LED1, the power/standby indicator. Initially when power is switched on, transistor Q1 is off and so pin 4 of IC7 is pulled high via the 10kΩ resistor connecting to the 12V supply. This allows the 555 timer to run and it flashes LED1 on and off.

The rate of flashing is set by the 10μF capacitor connected to pins 2 & 6 and the associated 100kΩ and 10kΩ resistors.

Note that the 10μF capacitor is tied to the +12V supply rather than 0V, as in a normal 7555 timer setup. The reason for doing this is so that pin 3 of the 7555 will be low when power is first applied and the LED will light immediately and then flash. If the capacitor was connected to 0V (as in a conventional 7555 circuit), the LED would be off for almost one second before flashing on.

In effect, the 10μF capacitor is charged via the 10kΩ and pin 7 and then discharged to +12V via the 10kΩ and 100kΩ resistors. Since the ratio of the charge/discharge resistances is 1:11, the LED flashes with about the same duty cycle (on for 70ms, off for 740ms) and thereby keeps current drain to a minimum when the amplifier is muted; LED1 draws about 400uA.

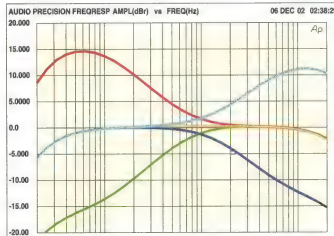


Fig.8: the tone control action in the "flat", "max boost" and "max cut" settings.

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When pin 7 of IC6b's output goes high to unmute the power amplifier, transistor Q1 is switched on and it pulls pin 4 of IC7 low. This forces the pin 3 output low and LED1 is lit continuously.

So LED1 is on continuously in normal operation and it flashes when the amplifier is muted.

Power amplifier

IC9 is the TDA1562Q power amplifier which can deliver up to 70W under music power conditions, depending also on the state of battery charge. The circuit presented here is very similar to that first presented in the March 2002 issue of SILICON CHIP. The main difference is that here we are using the mute (pin 4, Mode input) facility, as described above and the diagnostic output at pin 8. This is used to drive LED2.

It will show when the amplifier is clipping, if there is a short at the output, if there is an open circuit load and if the amplifier has gone into thermal shutdown.

If you want a full description of the TDA1562Q, you will need to refer back to the March 2002 issue. For those readers who have not seen that issue, we will briefly the describe the circuit operation.

The specified 200mm 4Ω woofer from Altronics has a separate concentrically mounted plastic dome tweeter and has quite a wide overall frequency response.

The TDA1562Q actually contains two power amplifiers which drive the 4Ω speaker in bridge configuration and its inputs are balanced. So we drive these balanced inputs (pins 1 & 2) with signals that are 180° out of phase.

Hence, pin 1 of IC9 is driven directly from the output of IC5b (albeit via two capacitors) while pin 2 is driven from the output of IC8, a TL071 op amp connected as a unity gain inverter.

The two 4700µF capacitors at pins 3 & 5 and pins 13 & 15 of IC9 are "lift supply" reserves for when momentary high power levels are required.

Both amplifier output terminals pass through Zobel networks, each comprising a 2.2Ω resistor and parallel inductor shunted via a 220nF capacitor. The components are included to guarantee stability (ie, stop any tendency to supersonic oscillation) when driving reactive loads.

Power for the circuit comes from a 12V 7 amp-hour battery which is fed via switch S1 and a 7.5A fuse. Diode D3 is included should the battery be connected the wrong way around. If that happens, the diode will conduct and blow the fuse.

Next month

In March we will present the charger circuit, which can be built as a general purpose charger as well as the power supply for this amplifier.

We will also present the full construction details of the PortaPAL PA amplifier. **SC**

The main PC board which includes most of the electronics: the power amplifier (the large IC attached to the heatsink), the mixer, tone controls and so on. Input "daughter boards" attach to this main board. The power supply is also on a separate board.

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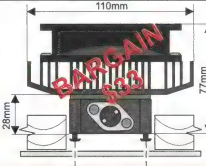

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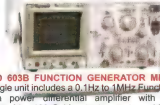

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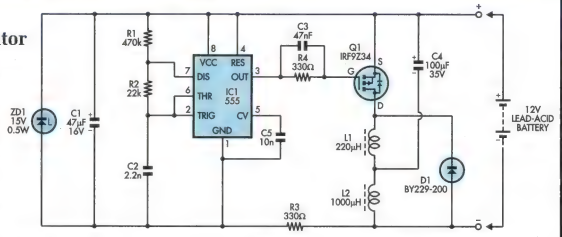
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

12V lead acid battery desulphator



Lead acid batteries often fail prematurely due to over-charging, under-charging, deep discharging and low electrolyte level. All of these can lead to sulphation of the plates which leads to high internal resistance and eventual failure.

Normally, this process is regarded as irreversible but this circuit is claimed to reverse the process by applying high voltage pulses to break down the lead sulphate compounds. The circuit is essentially a high-voltage pulse generator which is powered directly from the battery in question. If the battery is badly sulphated, it will be necessary to connect it to a low power charger as well, say 2A.

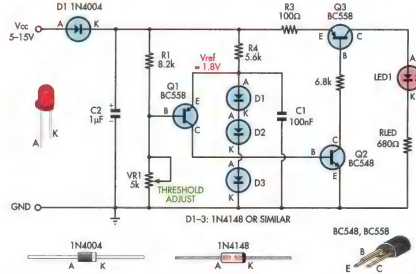
We have strong doubts about whether battery sulphation can be effectively reversed but we are publishing this circuit because the subject is of particular interest. This circuit has been submitted to us from a number of sources so we do not know who is the original designer. More information can be found at **http://shaka.com/~kalepa/desulf**

The 555 timer is connected as an astable oscillator with its output frequency set by R1, R2 and C2. Its output pulses drive the gate of Mosfet Q1 which turns on to charge inductors L1 and L2. At the end of each pulse, Q1 turns off and the inductors develop a high-voltage high-current pulse which is applied across the battery via fast recovery diode D1 and the 100µF capacitor.

The 555 is protected from the high voltage pulses via its isolated supply, by virtue of the 15V zener diode ZD1, the 47µF capacitor and the 330Ω resistor R3.

SILICON CHIP

Low supply rail detection circuit



Here's a simple low supply rail detection circuit that costs peanuts and takes just 20 minutes or so to make. Its power consumption is quite low, so it could easily be built into battery-powered devices.

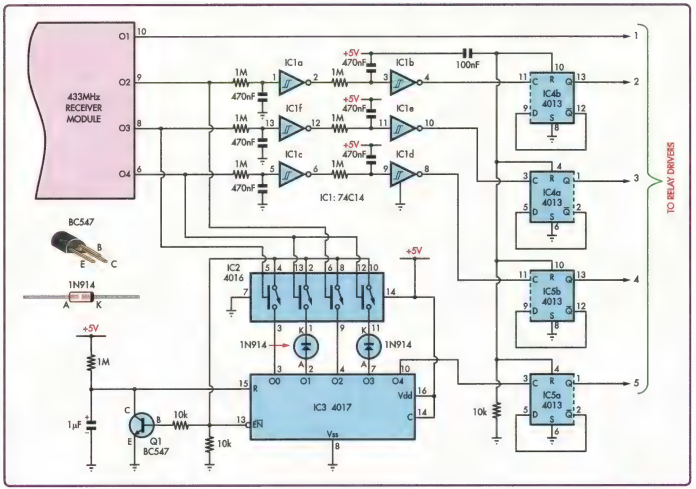
Instead of using an op amp, the circuit is built around three low-cost transistors (Q1-Q3). Diodes D1-D3 form a 1.8V voltage reference (Vref) for the emitter of Q1. If the voltage across the voltage divider formed by R1 and VR1 is less than this, Q1 turns on and supplies Q2 with base bias current. This turns on Q3 in proportion to this bias current which then drives LED1.

The brightness of the LED gives an indication of the severity of the low voltage condition. The brighter the LED, the lower the supply voltage.

Trimpot VR1 is adjusted so that LED1 just comes on at the desired low-voltage point. The current consumption is typically less than 2mA when LED1 is off.

Finally, the value shown for RLED is suitable for 6-12V operation. For other voltages, RLED can be calculated using the formula RLED = (VCC - 1.8)/0.01 (this equates to a current of about 10mA).

Trent Jackson,
Dural, NSW. ($30)



Fifth channel for code-hopping remote control

This circuit was developed as a refinement to the Code-Hopping 4-Channel Remote Control featured in the July 2002 issue of SILICON CHIP. As mentioned in the article, code-hopping prevents code-cracking of the transmission but you still have a problem if someone steals your remote transmitter.

This circuit adds a fifth hidden channel with its own entry code entered via the four existing buttons. This involves adding three low-cost CMOS ICs, a transistor and several resistors and capacitors (plus an extra relay and relay driver circuit).

The extra ICs include a hex Schmitt trigger IC1, a 4016 quad bilateral switch (IC2) and a 4017 decade counter (IC3). The existing 4013 dual D-type flipflops are retained.

The idea is to input a "sequential code" to the counter (by pressing the correct sequence of buttons on the transmitter), without switching the regular channels. This is achieved by delaying the rising edge of the receiver's output pulses by 0.6s, before they trigger the flipflops which activate the relay drivers. In other words, both the on/off and momentary functions work as before but are delayed by 0.6s.

To activate any of the regular channels, the relevant transmitter button must now be held down for about 1s or longer. Alternatively, to activate the "sequential code" fifth channel, the code must be rapidly entered in the correct sequence, with each button press less than 0.4s.

Here's how it works: initially, IC3 is held reset by the voltage across the 1µF capacitor. When the code is entered, the high on pin 3 of IC3 is applied, via CMOS switch IC2, to the enable pin (pin 13). As a result, Q1 turns on and discharges the 1µF capacitor, thus releasing the reset on IC3.

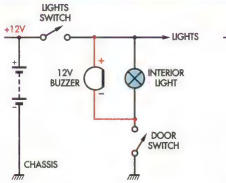
When this first button is released, pin 13 of IC3 goes low, advancing the counter by 1. Similarly, when the second button is pressed, pin 2 of IC3 goes high and the process is repeated.

After the last button has been pressed and released, the 'O4' output goes high for 0.8s while the 1µF capacitor charges and resets the counter. This high in turn clocks flipflop IC5a.

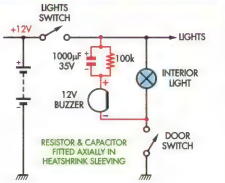
Note that only three channel buttons have delay networks, to keep the IC count low. This means that one button has to be used twice to get a 4-digit code. And that in turn means that their corresponding counter outputs must be fitted with blocking diodes.

The code for the circuit shown here is 3424 – ie, output O3 from the receiver module goes to the first switch in IC2, output O4 goes to the second and fourth switches, and output O2 goes to the third switch. As a result, blocking diodes are fitted between the O1 and O3 outputs of IC3 and pins 1 & 11 of IC2.

Manfred Schmidt,
Edgewater, WA.



SIMPLE CIRCUIT



IMPROVED CIRCUIT

Simple headlight reminders

These two headlight reminder circuits are easy to install and operate on the KISS (Keep It Simple Stupid) principle.

The simple circuit involves adding just a 12V piezo buzzer between the lights circuit and a door switch. The buzzer sounds if the lights are left on and you open a door.

The disadvantage of this simple circuit is that it's annoying to have the buzzer sound continuously if you want to leave the door open while the lights are on.

The improved circuit overcomes that problem by adding a 1000µF capacitor and a parallel 100kΩ resistor in series with the buzzer. Now, when a door is opened, the buzzer gives a brief burst of sound only, while the 1000µF capacitor charges. The 100kΩ resistor discharges the capacitor when the lights are switched off.

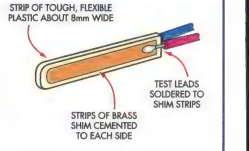
Andrew Gibbs,
Jindalee, Qld. ($30)

In-situ battery test probe

This item describes a simple probe that allows in-situ AA and AAA battery voltage and current drain measurements without removing the cells from the holder.

In use, the probe is simply pushed between the positive end of one cell and either the negative end of the adjacent cell or the battery holder terminal. The probe leads are then plugged into a multimeter set to a voltage range and the device switched on so that the no-load voltage can be read.

Switching the multimeter to a current range allows the device to power up so that the current drain can be read. Warning: be sure your meter has a fuse in its current metering circuit, in case the device being tested has an internal short.



The prototype probe was made by gluing strips of brass shim (using plastic adhesive) to both sides of a strip of tough, flexible plastic.

Robin Stokes,
Armidale, NSW. ($25)

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As you can see, we pay good money for each of the "Circuit Notebook" contributions published. But now there's an even better reason to send in your circuit idea: each month, the best contribution published will win one of these superb Wavetek Meterman 85XT true RMS multimeters - valued at around $380! So don't keep that brilliant circuit secret any more; send it to SILICON CHIP and you could be a winner!

Contributions must be your own original work or a major adaptation and not published elsewhere nor submitted for publication elsewhere. SILICON CHIP's decision is final.

Automatically armed engine immobiliser

Most immobilisers, once armed, do not allow the vehicle to be started. By contrast, this design is automatically armed each time the ignition is switched on and allows the engine to be started. The engine will then continue to run for about 9 seconds but will stop unless the immobiliser is disarmed using a small transmitter.

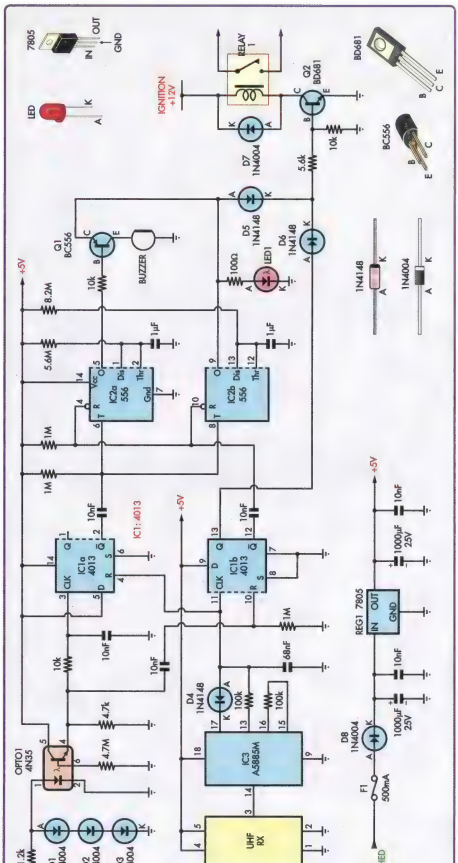
Alternatively, the immobiliser can be disarmed after the ignition has been turned on but before the engine is started.

The logic behind this approach is to fool the thief into thinking that the car is faulty and abandon it.

When the ignition is switched on, the LED in optoisolator OPTO1 is turned on (D1-D3 and R1 limit the voltage across the LED to about 1.8V). The transistor in the optoisolator then conducts and resets IC1b, part of a 4013 dual-D flipflop, via a 10nF capacitor. As a result, pin 13 of IC1b is initially low.

At the same time, the 10nF capacitor on pin 3 of flipflop IC1a charges via a 10kΩ resistor and causes pin 2 of IC1a to go low. This in turn triggers both sections of IC2, a 556 dual timer. As a result, pins 5 & 9 of IC2 both go high. Pin 9 turns on LED1 (a flashing LED fitted in the dashboard) to indicate that the immobiliser is armed and also supplies +5V to the emitter of Q1.

During this time, Q1's base is also at



+5V (pin 5 of IC2a is high) and so Q1 is off. By contrast, Q2 is biased on by the high on pin 9 of IC2b (via D5). This activates the relay and allows the vehicle to start.

Both sections of IC2 now start their timing sequence. After about 6s, pin 5 of IC1a goes low (as set by the 5.6MΩ resistor and 1µF timing capacitor) and this turns on Q1 and sounds the warning buzzer. This alerts the driver that the immobiliser is still active.

If the immobiliser isn't disabled, pin 9 of IC2b goes low after about 9 seconds. When that happens, LED1 stops flashing, the buzzer stops and the relay turns off, stopping the engine.

Because IC1b is reset when the ignition is switched on, its Q output is low. As a result, the circuit will remain in this condition, even if the ignition is turned on and off repeatedly. The vehicle is thus effectively immobilised and cannot be restarted without the transmitter.

Pressing the button on the keyring transmitter (Oatley Electronics TX2) before the timing sequence is complete resets the timers (and holds them in the reset condition). It works like this: when the UHF receiver (Oatley Electronics RX4) receives an encoded signal, its output is fed to decoder IC3 (Oatley Electronics A5885M). If the code is valid, IC3's output goes high and clocks IC1b.

As a result, IC1b's Q output (pin 13) goes high to ensure that Q2 and the relay remain on. At the same time, pin 12 of IC1b goes low and resets both timers via a 10nF capacitor, causing their outputs to go low. This in turn causes LED1 to stop flashing and silences the buzzer (if it is sounding), ready for the next timing sequence.

IC3's output also resets IC1a, so that it is ready to change state next time the ignition is turned on.

The contacts of the relay can be connected in various ways to disable an engine. These include interrupting the +12V supply to any of the following: the ignition coil, fuel and gas cutoff solenoids or fuel injectors. In addition, you can open the connection to the starter motor solenoid to prevent the engine being cranked.

Note that the relay should be a heavy-duty automotive type with 30A contacts.

Don Adamson,
Mt. Duneed, Vic. ($50)

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K 3438

ETI Dec '79

SAVE $8

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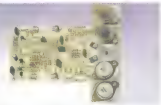

100W Amp Module Kit

You can use two of these for stereo, giving a massive 200W output. Has a power output of 100W into 4 ohms. Requires a +/- 40 volt power source. Supplied with all components, PCB, fuses and transistor mounting bracket.

K 3442

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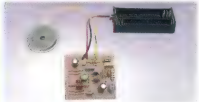
SAVE $14

$29.78



VHF FM/AM Radio Kit

This easy-to-build VHF receiver uses slope detection for FM stations. Local VHF AM airport radio services can also be received. Supplied with all necessary components.

K 3015

SILICON CHIP Dec '02

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Mighty Midget Amp Kit

This compact audio amplifier module can deliver up 70W into a 4 ohm load when powered from a 12V car battery. Supplied with all necessary components.

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K 3121

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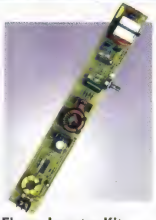

Fluoro Inverter Kit

A high efficiency inverter for fluorescent tubes. Will power 36W or 40W tubes from a 12 Volt battery to full brilliance. Kit supplied with all necessary components.

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EPROM Programmer Kit

EPROM programmer that is controlled via a PC parallel port. Can handle EPROMs from 2716 (2K x 8) to 27256 (32K x 8) and 2816/2864 electrically-erasable PROMS. Supplied with components, 2 EPROM test sockets, case, pre-punched screened front panel display and PCB.

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EA Sept '93

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CATALOGUE CHIP Jan '01

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CATALOGUE CHIP Dec '01

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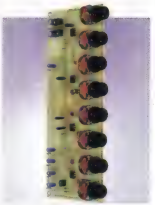

4 Channel Mixer Pre-amp Kit

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K 5400

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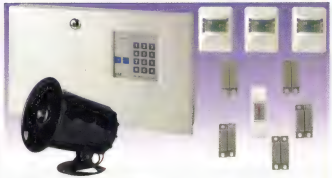

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Short range, high-performance wireless modem

The applications for radio as a medium to connect devices is virtually unlimited. Some applications demand wireless connection, due to difficult access or for mobility reasons. Others, such as metering and data acquisition systems can benefit greatly from wireless technology. No network cabling and no direct access to equipment is needed, reducing costs right from the installation stage and beyond.

The **WM232-UHF**, an Australian-designed and manufactured radio modem, is a low-cost, plug-'n'-play connectivity solution for devices that communicate via serial links. It supports on-air data rates of up to 14.4kbps and features data encryption, error checking and acknowledged data transfer.

The basics

The modem is housed in a small ABS plastic case, measuring about 103mm (L) x 62mm (W) x 24mm (D). Antenna hookup is via an SMA connector that protrudes through one end of the case. A tiny (60mm) helical stubby antenna can be mounted directly onto the SMA connector, making a very tidy little package.

Power for the unit can be provided

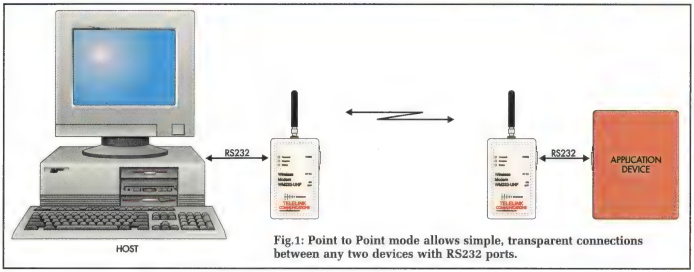


Fig.1: Point to Point mode allows simple, transparent connections between any two devices with RS232 ports.

by either an internal 9V PP3 battery or an external 7-15V DC source. A 9V DC plugpack was supplied with our evaluation unit. The average current drawn during transmit/receive is quoted at 40mA, falling to 15mA when idle.

This means that an external power source will be necessary for most applications. In power-down mode, consumption drops to a more respectable 400µA.

Connection to the modem is made via a 9-pin female 'D' connector. Pin assignments conform to the PC modem (DCE) standard, so for connection to a PC (DTE) serial port all that's required is a 9-way pin to pin cable (supplied).

The unit operates in the 433.920MHz LIPD (license-free) band, with transmit power limited to 10mW (ERP) to satisfy the regulatory requirements.

Receiver sensitivity is quoted at -100dBm for a 1ppm BER (Bit Error Rate), giving a range of about 300m line-of-sight and 50m indoors with the helical stubby fitted.

An optional coax-fed, ground-independent half-wave dipole extends the range to around 500m line-of-sight. Of course, you could also fit a more elaborate "gain" antenna for much greater range, but that wouldn't be legal, now would it?

Wireless simplicity

In their simplest configuration, two WM232-UHF modems can function as a reliable two-way wireless link.

Apart from a certain amount of latency in the data exchange, the modems appear transparent to the connected devices, functioning just as they would if they were hard-wired together. This mode of operation is called "Point-to-Point".

For more demanding applications, multiple pairs of modems can operate within the same air space.

This is achieved with a two-tier addressing system, composed of "unit" and "site" addresses.

Up to 16 pairs of modems can operate within a single site address, with up to eight possible site addresses. This corresponds to a maximum of 127 possible point-to-point links.

Site addressing effectively partitions groups of modems for repeating purposes. Any WM232-UHF can operate as a dedicated repeater unit.

Up to three repeaters can be used within a network to extend the operating range. A repeater retransmits any data it receives with the same site address, allowing very flexible networks to be constructed.

It is important to note that effective data throughput for any pair in a network will decrease as the network is expanded, as the available airtime always remains constant.

An LBT (Listen Before Transmit) scheme is employed to minimise the interference that occurs when multiple modems attempt to transmit simultaneously.

More about networking

A common requirement within a wireless network is to be able to monitor and control multiple nodes from a central

Features

- √ Easy configuration via PC, laptop or PDA.
- √ Point to point or multipoint network capability
- √ Repeater support for increased range
- √ Serial port speeds of 600 to 115200 baud
- √ On-air data speeds of 600 to 14400 baud
- √ On-air data encryption and error checking
- √ Diagnostic "Radar" and "Ping" functions
- √ DTR-controlled "sleep" mode
- √ Internal 9V battery or external DC plugpack
- √ Range of up to 500m with coax-fed half-wave antenna
- √ CE & Australian C-Tick approval for use on licence-free UHF Band

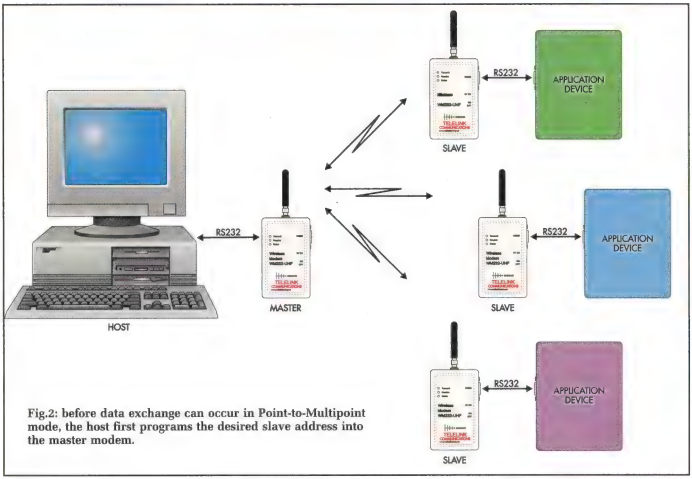


Fig.2: before data exchange can occur in Point-to-Multipoint mode, the host first programs the desired slave address into the master modem.

location. This is the purpose of the "Acknowledged-Point-to-Multipoint" mode, where a single modem is configured as the master and all other modems as slaves.

Each slave is assigned a unique address, using the same addressing scheme employed in Point-to-Point mode.

In order to communicate with a particular slave modem, the host must first program the desired slave address into the master modem. In Acknowledged-Point-to-Multipoint, the master modem must initiate a link with a slave before data transfer to or from that slave can occur.

By contrast, "MultiMaster" mode allows up to 15 slave modems to initiate connection with a single master unit. In this mode, data transfers must be kept as short as possible to prevent "hogging" of available airtime.

Design your own network

If none of the above modes suit your requirements, then it is possible to design your own network from the ground up using "Broadcast Multidrop" mode.

In this mode, all aspects of network management, including routing, node addressing and error recovery, are assumed to be host-controlled.

Data sent to a modem over its RS232 link is transmitted (broadcast) to all modems within range.

Receiving modems simply decode the data and pass it on to their hosts.

Configuration

Modem configuration is accessible, strangely enough, via configuration mode. A PC, laptop, or PDA with an RS232 port and suitable terminal software (such as HyperTerminal) are required for the job.

Normally, modems automatically enter data transfer mode at power up. To exit data transfer mode and enter

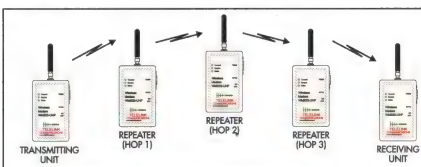


Fig.3: any modem can function as a dedicated repeater. Up to three repeaters can be added to a network, greatly extending the operating range.

configuration mode, it's just a matter of sending an "escape" sequence from the terminal program. The factory default sequence is three consecutive "+" characters.

Typing "help" at the configurator prompt displays all possible commands, whereas "list" displays current settings (see Figs. 4 & 5). A variety of useful commands allows mode and address selection and fine-tuning of network parameters.

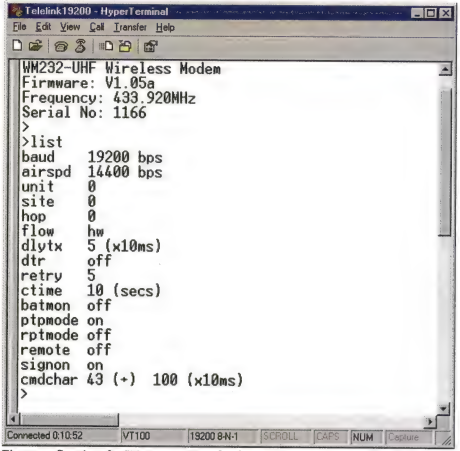


Fig.4: configuring the WM232-UHF is dead easy. Here, we've used the "list" command to show all configurable parameters.

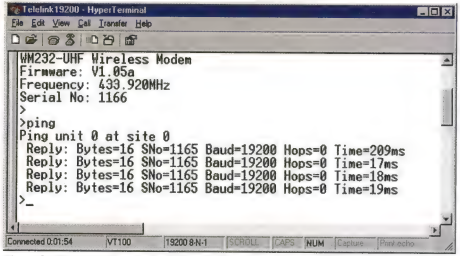


Fig.5: the "ping" command is a handy "go-no go" test and allows quick verification of modem addresses.

It's also possible to modify most of these settings remotely, from a second modem via a wireless link. Of course, this feature can be disabled for security purposes if so desired.

Link testing

Two diagnostic commands have also been included to aid network setup and testing.

The "ping" command looks for a modem within range with the specified address and returns its status. This is a useful "go-no go" test and it allows verification of which unit addresses are in use.

The "radar" command allows link range and reliability to be quickly determined. This mandatory feature will help to eliminate most of the guesswork from a simple network installation.

Impressions

Setting up a simple, reliable wireless network with these modems should be a painless exercise.

And if you have something more elaborate in mind, the WM232-UHF can probably handle that too.

Getting more information

The WM232-UHF Wireless Modem is manufactured and sold in Australia by Telelink Communications, phone (07) 4934 0413 or email sales@telelink.com.au.

You can reach them on the 'net at www.radiotelemetry.net **SC**

WM232-UHF Modem and Accessories Prices (inc. GST)

WM232-UHF Modem:	$361.90
WM232-PSU Power Pack	$ 27.50
ANT-UHF-H SMA Helical Antenna	$ 26.40
ANT-UHF-Q SMA 1/4 Wave Antenna	$ 28.60
ANT-UHF-D 3dB Industrial Dipole	$ 42.90

A PC Board only version of the WM232-UHF is available for OEM's. (prices on application)

240V MAINS FILTER FOR HI FI SYSTEMS

Are you irritated by clicks, pops, spruigles and sundry other noises in your hifi system? Chances are they are getting in via the mains wiring. Here's an easy-to-build mains filter which should put an end to those annoyances.

By Ross Tester

What we have done here is taken a commercially-designed mains filter kit and modified it ever-so-slightly to make it more acceptable – not only for Australian wiring rules and practices but also more acceptable as far as the end user is concerned.

As well as making a few mechanical changes to the circuit (which we will cover shortly), we also added a four-way powerboard so that the filter goes between the mains plug and the four outlets. That way, all (or at least four!) devices could be plugged into clean mains.

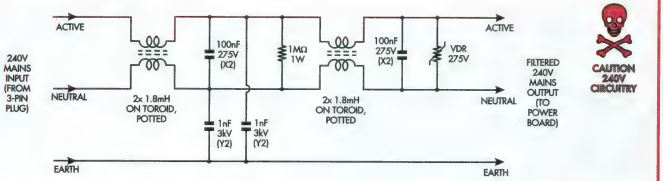
Incidentally, there is nothing to stop you using a six-way or even eight-way power board if you wish. But four-ways are now really cheap – often less than four bucks each at Woolies (and no doubt other stores!).

The documentation and PC board both state a maximum loading of 2300W – this would be more likely 2400W in Australia with our 240V system. But if your hifi system draws anything like 2kW, please let me know before you turn it on so I can leave town!

Where's it from?

The kit came to us from Leon Gross of the Soundlabs Group, a purveyor of high-end sound equipment. The actual design (and kit) is marketed by LC Audio Technology, of Denmark, as the "NETfilter".

On first inspection, we were quite impressed with the layout and quality of the kit. As our circuit (Fig.1) shows, it is an LC design with the chokes formed on toroids and



SC 240V AC MAINS FILTER

Fig.1: the circuit consists of two LC filters and a voltage-dependent resistor. All sections of the circuit are at 240V so take extreme care.

pre-potted. We imagine that these chokes might contribute a significant portion of the overall kit cost.

Similarly, X2-rated capacitors are used, giving a high margin of safety.

The kit includes a cleverly-designed PC board which mates with a snap-together ("clamshell" type) plastic case. No mounting screws or bolts are needed to hold the board in the case – once the board is mounted in the case (it will only go one way due to various cut-outs on the board) the case is closed and fully encloses the bitey bits.

Just a word of caution before we go any further: yes, this device operates directly from the 240V mains and could therefore be lethal if used outside of the case. Never work on a live board either outside the case or with the case not snapped closed.

The circuit

The filter is a traditional LC type. The graph of Fig.2 shows the attenuation achieved (in dB) vs frequency. This was measured using a 75Ω input and 75Ω output HF generator and AC millivoltmeter.

There are four inductors in the circuit, all 1.8mH. The inductors are supplied pre-wound and potted. A 100nF capacitor is connected across the Active/Neutral after the inductors. The "X2" after the value doesn't mean there are two of them – it means that the capacitor is an X2-type. These have ratings sufficient enough to cope with this role.

Immediately following the first capacitor and in parallel with it is a 1MΩ resistor. This is to bleed off any charge on the capacitors when not in use – to save you getting a not particularly dangerous but nevertheless annoying bite, if you touched the 3-pin plug Active and Neutral pins.

This resistor is a 1W type – not because it must dissipate that amount of power but to get an acceptable voltage rating. (The resistor would in fact only dissipate around 0.05W).

Two 1nF capacitors, each rated at 3kV, connect between the Active and Neutral lines and the Earth line. These are responsible for getting rid of any high-frequency garbage which might be on the line.

Following a second pair of inductors in series with the Active and Neutral lines, there is another 100nF X2 capacitor forming a second LC circuit, along with a voltage-dependent resistor (VDR – also known as a MOV) .

The VDR offers a high resistance at the normal mains voltage (240V) but when the voltage rises significantly above this (as it could with a spike on the mains), its resistance drops, effectively shunting the spike away from the output.

The earth lead

One area where we had to make changes to the circuit involves the earth lead.

While the documentation which came with the kit went to great pains about not using the mains earth but instead running a separate earth lead to a "ground stake", we

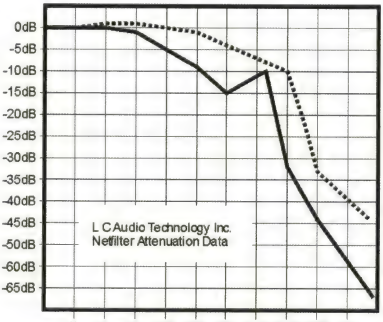
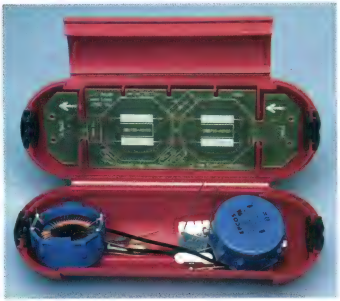
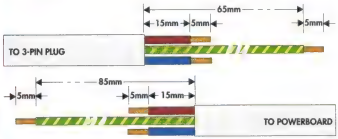


Fig.2: this graph shows the filter's attenuation in dB vs frequency.



Here's what the kit of parts looks like. This shot also gives a good idea how the PC board slots into the clamshell case. The arrows on the PC board go from mains in to mains out.

The completed PC board, ready for insertion in the case.



Here's how to cut and strip the mains cable between the plug and powerboard. Just where you cut it is up to you – you could even make it a longer cord if you wished.

believe this would be illegal under Australian wiring rules.

(Their rationale, by the way, is that the mains earth is often noisy in itself. This may or may not be true, depending mainly on how well the earth wire is actually earthed).

But many overseas countries do not have the "multiple earth neutral" or MEN system used in Australia, where every building must have its own earth and the earth is bonded to the neutral at the switchboard.

Unless a device is manufactured – and specifically labelled – as "double insulated, do not earth" an earth wire must be supplied to that device – hence the Australian 3-wire mains lead (Active, Neutral and Earth).

Sometimes people get into trouble with earth loops, causing hum, because of this multiple earth system and cut the earth lead to one or more of their hifi devices.

Sure it works – until something goes wrong and a tiny signal earth lead is required to carry fault current. It fails, and the device is live. This can kill (and indeed has done so in the past).

Therefore, we made some mechanical changes to the circuit to ensure that the earth lead was not only used but stayed intact from input to output.

Cord anchorage

This was the other area of concern – and it was a real problem. Despite trying several times, we could not get the mains cords (input and output) to grip properly with the anchorage and terminal blocks supplied.

Our test was simple: two people pulled on the cords to see if they would separate. Unfortunately, they invariably did. Not happy, Jan!

Fortunately, the answer was really simple: scrap the mains terminal blocks, drill out the holes they were supposed to sit in so they would accommodate the mains wires and solder them in. This also gave us more "meat" on the outer cable for the cord clamps to grip to.

What about the earth wire?

On the input side, we drilled a new 2.5mm diameter hole in the space between the two now unused holes, right in the centre.

We passed the earth wire (including insulation) right through this hole, then snaked it across the back of the board to the point marked "true earth connection". We soldered the input earth wire to this point.

Then we repeated this for the output side – exactly the same process, with the "output" earth wire also soldered to the "true earth connection" point.

Now when we repeated our tug-of-war test, no problems. Even when tugging much harder than we would

You need to make a couple of modifications to the PC board – drilling out four holes and drilling two new ones, to accommodate the different mains cord attachment method we use. This back-of-board diagram is approximately 1:1 scale.

reasonably expect, or applying short, sharp tugs, the mains wiring never moved.

Happy, Jan!

Construction

We've already detailed the process for the mains lead connections – just follow the diagrams for the cable cuts and lengths. Where you make the cut on the cable depends on your circumstances – it can go nearer the 3-pin plug, nearer the 4-way powerboard, or in the middle.

If you wish, you could even use a new piece of 3-wire mains cord with a 3-pin plug and extend the length of your powerboard/filter assembly to save using extension cords.

The rest of the construction is pretty straightforward, especially if you refer to our photos and PC board overlay diagram.

As usual, start with the low-profile components (resistors, 1nF capacitors) Don't mix up the VDR with one of those capacitors. Next fit the two 100nF capacitors and finally the two potted chokes.

The chokes are identical and symmetrical – they can go in either way and in either position. It's impossible to get them wrong!

Check out your soldering and component placement very carefully (even though it's hard to make a mistake on this board, solder bridges could prove briefly very spectacular!).

Now place the assembled board in the plastic case – it can go either way up but logically the components should face upwards. Make sure the three small notches on the edge of the board line up with the three pins in the case.

Fold the top of the case over and squeeze very tightly – the case will snap closed – and that's all there is to it.

Note that once the case is closed, it is (deliberately) quite difficult to open up again. It can be done, but . . .

Using it

All of your hifi devices (amplifier, tuner, cassette, CD, DVD, etc) should be plugged into the filter, otherwise mains-borne noise may get in elsewhere.

It may be even better to attempt a cure at the source of the noise rather than at the hifi end. In the past, we have used filters which made little or no difference at the amplifier end but stopped noise from a refrigerator completely when the 'fridge was operated via the filter.

It's basically a matter of experimenting for the best results.

SC

Where from, how much?

The complete kit of parts, (minus the powerboard of course), is available from Soundlabs Group, PO Box 307, Surry Hills, NSW 2010, for $99 inc GST (not including p&p). **Please note this is a special price, exclusively for SILICON CHIP readers – normal retail price is $125.00.** You can order the kit direct from the Soundlabs website – www.soundlabsgroup.com.au; by phone – (02) 9660 1228; or by fax – (02) 9660 1778. Don't forget to mention that you are a SILICON CHIP reader to get that special price!

We have been advised that Soundlabs Group intend to modify future kits according to this article, so the PC board drilling may already be done for you.

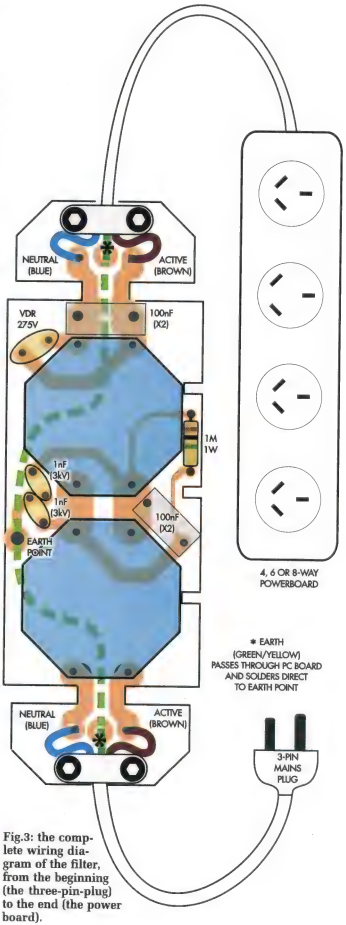


Fig.3: the complete wiring diagram of the filter, from the beginning (the three-pin-plug) to the end (the power board).

SERVICEMAN'S LOG

Servicing can be frustrating

Yes, frustration would seem to be the name of the game this month. Of three tricky jobs tackled, only one was successful. It took a contributed story to brighten the scene.

When a 10-year old 80cm Philips Matchline 33FL1880/75R (FL1.1-S AA) TV set came into the workshop I thought it would be routine. Considering my experience with the Philips Matchline FL1 series of TV chassis, I consider myself to be something of an expert on these. Unfortunately, I soon learnt the meaning of the phrase "pride goes before a fall".

Truly, this came close to being one of my worst disasters yet.

The set came in with an "intermittent dead" label attached to it. But for the first two weeks, it behaved faultlessly, producing an excellent picture. Then, during the third week, I saw the problem for the first time. The set would start OK in stand-by but wouldn't come on. All the front seven LED display indicators were flashing, in turn, in various combinations. Sometimes the set would come on and then later stop with the same flashing indicators.

Supposedly, each of these flashing indicators represents an error code but when they all flash, what does one do? Not every single circuit can be faulty!

I obtained a service manual for the FL1.1 chassis. Unfortunately, large chunks of the manual were completely different to the set I was looking at. In the end, I settled for a mixture of the FL1.0, FL1.0S, FL1.1 and FL1.1S (and even the FL1.2). However, this particular model still had differences that weren't covered in any of them (eg, the bridge rectifier is a single D5SBA60SIN block and not four separate diodes as all the service manuals showed).

The next thing was to engage the SDM (Service Default Mode), which provides microprocessor diagnostics. This is done by shorting inaccessible test points S24 and S25 deep in the bowels of the small signal panel. I have given up trying to kill myself and the set by reaching these parts; I now always mount a self-centring toggle switch on the rear so I can go easily into Service Mode S23 and S24, as well as the SDM.

That done, I examined the SDM figures on the OSD (On Screen Display): "SERVICE. 08 10 99 23 09".

I interpreted these to represent the fault codes for the last five breakdowns, 08 being the first and 09 being the last. 08 means a PSI/Control fault and 23 means System/Ident fault. Code 09 means a video control fault. These are matched by front-panel LED display combinations. On paper, this looked great but I couldn't find what 10 and 99 meant.

Supposedly, the SDM is meant to override the LED flashing but in this case, it didn't always do this. Anyway, to refresh the error code list, I switched the set to stand-by with the remote control and put the back on before reapplying the SDM. This now gave a row of zeros, "SERVICE 00 00 00 00 00", ready for the next time the set faulted. It wasn't too long before it did, giving "SERVICE 00 00 00 09 99". I examined IC7430 (TDA4680) in the video control for 09 code but couldn't see anything wrong. The 99 code made no sense at all.

Items Covered This Month

- Philips Matchline 33FL1880/75R (FL1.1-S AA) TV set
- Shamrock SRC2102L tech. monitor.
- Teac CT-M5928 TV set.
- Audioline FF895 cordless telephone.

By now I noticed the code most often given on the front panel was the "mute", "stand-by" and "stereo" LED displays and so, as a last resort, I followed a fault-finding flowchart in the manual. This eventually suggested I check (Test Point) TP56 at Plug L40-1, which I did. This measured 4.4V which implied I had a SOPS (Self Oscillating Power Supply) fault.

Getting this chassis into a suitable position for servicing is precarious at best. Basically, the chassis slides out after releasing plastic catches on either side of the boards. It can then be pulled back, along with the control modules, until it clears the runners. That done, I balanced it vertically on the bench with the two boards at an angle to each other. I couldn't find brackets F, nor were the leads long enough to use the service position shown in the manuals.

Thus far, the diagnostic system wasn't really making much sense so I started making voltage measurements to see what was happening. I had 18V (TV START) on (Test Point) TP60 and 5V (STBY) on TP50. TP56 was mostly at 4.4V but sometimes at 0.79V. However, when the set was working, it was 17.5V.

I also had 280V on V1 and, in the fault condition, there was 141V on TP57. In an effort to make life easy, I replaced the SOPS drive unit module from a good working set but it made no difference.

Next, I decided to examine the protection circuits but before I could get very far, one final indignity occurred. Though the set had been completely off for quite a while, I accidentally received an electric shock from the collector of chopper transistor 7216.

But that wasn't the end of it. With-

out thinking carefully, I decided to discharge the main electro through the powerful chopper transistor by biasing this transistor on using my multimeter – ie, by setting the meter to the x1 ohms range and connecting it between base and emitter. This worked really well – the voltage was removed from its collector immediately. What I didn't realise was that this had also damaged the transistor, so that when I switched the set on the next time, there was an almighty bang followed by a deafening silence.

Well, I had done really well for myself. I not only had the original intermittent fault to deal with but a much more serious fault as well. The explosion had destroyed the main fuse, the on/off switch, the bridge rectifier (a massive 25A job), the chopper transistor (7216), two diodes (6217 and 6218) and the SCR (6228) – not to mention my ego, which was left crushed and bruised. Perhaps I should retire now?

Patiently, I diagnosed and replaced each destroyed part but some of these items were no longer available. The 2SC3973B had to be replaced by a lower tolerance 2SC3973A, and I had real trouble matching up the two 1N5602 diodes. I was lucky with the bridge rectifier but I had no hope with the SCR, which was an S0824NH (the circuit called this a BT150). Neither is available anywhere.

I tried a variety of substitutions but all I achieved was a momentary picture, before it closed down with R3227, a posistor in parallel, getting extremely hot. I discovered that the original SCRs are high-voltage high-current "sensitive gate" devices, which are now an extinct species. I must confess that, until now, I had never heard of these components!

Fortunately, I was saved by a SILICON CHIP staff member, whose modesty prevents me from naming him. He designed a little circuit that used a sensitive gate SCR (C106D) to trigger a main SCR (TYN816) substitute. I made up this neat little circuit, mounted it underneath the main PC board and it worked really well.

So now I was back at the beginning, ready to tackle the six protection circuits. There is only one way to deal with these and that is to disconnect them one at a time and monitor the base voltage to transistor 7381, which should be 0V.

THIS CAME CLOSE TO BEING ONE OF MY WORST DISASTERS YET

It sounds simple but it's not, especially when the fault is intermittent and operating on three protection circuits. The first was the sound protection circuit, which I am sure I would have picked up earlier had I been provided with the external loudspeakers needed for this set. The problem here turned out to be IC7000 (TDA1521Q) and C2071 (which I changed to 330μF).

The second fault involved the overvoltage protection and this turned out to be D6375 (LL4148) and D6376 (LLZC18V), the latter a surface-mount zener.

The third problem had me really stumped. It was the EHT protection line off pin 13 of the horizontal output transformer, and it was very intermittent, sometimes taking several days to show. In desperation, I changed every part of the circuit and it still played up. Someone suggested desensitising the circuit by changing some of the values but in the end, I was so fed up with it that I just disconnected it and left it on test.

Well, of course, two weeks later the inevitable happened and the set died again. This time, one of the horizontal output transistors (7504) was short circuit. This device can be either a BU508AF, ON4673A, 2SD1884 or 2SC4288A but the important thing is to check tuning capacitor C2504 (470pF) and C2523 (8.2nF). This time, I didn't stuff up – C2523 measured only 6.7nF. I replaced this and upgraded C2504 to a 3kV ceramic type

I then found that the east/west output transistor (7610, 2SA1359) had also been taken out. I replaced this and reconnected the EHT protection line. My persistence was rewarded – the set now fired up correctly and was still working four weeks later. It was just as well, as it was either me or the set. I had already written the note and loaded the gun!

But I still don't know what fault code 99 means. Can anyone enlighten me?

Shamrock revisited

The Shamrock story, which started back in December 2002 but was left in

limbo, has progressed – just a little.

A friend who specialises in monitor repairs very kindly offered his services and, working without a circuit, fixed the east/west pincushion problem.

He also located the smoking device that I couldn't trace. It turned out to be R495 which feeds ZD404, Q417c, U405 pin 4 and much more. Unfortunately, the smoke had also discoloured the resistor's colour code. He guessed it to indicate 100Ω but checking in his own set suggested this could be a common fault as that, too, had been replaced with a 180Ω 5W resistor.

I was thrilled about this but sadly a new fault had developed which has brought me full circle. When the set warms up, the beam current rises and the power supply makes "chirruping/squealing" noises, and then closes down. Using freezer, I traced this to an area in the power supply around Q108/D107 (the FET driver) and IC U102, but I was unable to find the offending part. (I changed all the electros).

Yes – it's all very frustrating but I am still hopeful that someone out there might have a circuit diagram.

Teac CT-M5928 TV set

Unfortunately, that wasn't to be the end of my frustration this month. I had another Chinese built 5-year old Teac CT-M5928 come in with the repair docket saying it was dead, and that it was really urgent, as its owner was moving interstate.

As usual, I felt pretty confident this was going to be quick and easy; after all, I had a circuit diagram and plenty of experience with these models, plus lots of parts in stock.

With the back off, it didn't take long to find that the problem was due to no horizontal drive from pin 26 of IC102 (TDA8305A) to transistor Q401. Actually, it wasn't strictly true that there was no drive but the oscilloscope showed only a brief burst before the signal died almost immediately. Waveforms were also present on the horizontal driver and output stages but, as expected, they too collapsed along with the drive.

All the voltages from the separate power supply were correct at 143V, 18V and 18V, as were all the 12V and 5V rails. Obviously, as I had no horizontal output stage operation, I could not yet check the voltages emanating from there.

All I had to do, it seemed, was find out why there wasn't a consistent output from the jungle IC. This is a very popular Philips IC and is also used in their sets, notably the GR1 AX. Being a jungle IC, I was only really interested in about a dozen pins pertaining to the horizontal drive output circuit.

I had a very similar model soak-testing in the workshop (AWA6850SH) and I quickly jotted down all the pin voltages of this IC and then compared them with the faulty set. Naturally, because the faulty set wasn't working, not all voltages could be compared.

Pin 7 was for the 12V input, which was correct, with no appreciable ripple. This 12V also supplied the vertical oscillator on pin 2 and the horizontal drive on pin 26.

I established that the horizontal drive was still present on the good set , even when its horizontal output stage was disabled. This was important because it may have been that the 12V from the secondary of the horizontal output transformer may have affected the horizontal phase on pin 28 which it eventually supplies. I then found that the faulty set couldn't supply substantial output with or without the horizontal drive circuit being connected to the horizontal driver transistor (Q401).

I removed the 28-pin jungle IC and fitted a socket in its place. I then swapped it with the IC in good set but it made no difference. Back to the drawing board.

Just in case there was something wrong with the 12V supply (I didn't really think there was), I connected an external power supply to R125 and then added the 12V supply from the horizontal output transformer. Again, nothing changed.

By now I was beginning to feel nerv-

ous and time was ticking by. I measured every component (15) attached to pins 23-28 and also replaced all five electrolytic capacitors around the IC. Once more I drew a blank.

It was at this point that I had some good luck. I was about to check all the waveforms around the IC and was in the process of winding up the external power supply when I noticed that, in the range from 7-9V, the horizontal drive would come on and actually stay on! I then reconnected the horizontal output stage and repeated the operation. This gave sound and a picture, complete with colour – in fact, almost everything was working.

But this was all quite unexpected and had me really confused. I spent some considerable time experimenting with the power supplies to pins 7, 2, 28 & 26, as well as to pin 11. In the Philips set, the latter is used to start the horizontal oscillator but in this set, there is only a resistor to chassis.

Unfortunately, none of this was leading anywhere. The best I could do was fit a 33Ω resistor from the 12V supply to pin 7 to make the set work. If the voltage increased beyond 9.5V it stopped. And I did start to notice other deficiencies with the set's operation. First, the sync was somewhat weak. Second, the AGC was prone to make the tuner IF stages overload and the RF AGC control apparently did not have any effect.

Third, the automatic tuning system did not stop after a station was tuned in. And finally, the colour would occasionally change its phase – even when using a colour bar generator connected to the AV input sockets. However, all this could be because the rest of the IC was underpowered.

But time was up – the client just had to have the set back. I told him of the developments and, somewhat disappointed, he just collected the set and left. I was equally disappointed – I had given it my best shot but it wasn't good enough.

Afterwards I went over my notes to try to see if I had overlooked something on the sandcastle line to pin 27. This was a 2-way connection, with sandcastle pulses going out and horizontal output pulses coming in from R419, R420, and C433 to the horizontal output transistor (Q402).

It's too late now of course; the set has gone but I sure would like to know what I missed!

Now, on a brighter note, here is a contribution with a happy ending. It comes from J. B. of Hampton Vic. This is how he tells it.

Audioline cordless telephone

Following a recent electrical storm in our area, I ended up with an Audioline FF895 cordless phone on my bench. This is an upmarket phone, with multiple handsets and lots of features.

The reported failure was that the it would not connect to the phone line. Apparently, it had been taken to two other repairers who had declined to repair it.

Examination revealed that the handsets appeared to be working OK and that the base station had most of its functionality, the main problem being that it could not get a dial tone.

I had no circuit information about the phone and not

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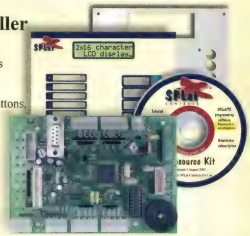

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I TINNED EACH OF THE PCB PADS...

being very familiar with their workings, simply carried out a few basic checks. The plugpack was OK but I thought I was on to something when I measured the input resistance (DC) of the phone line connection and found it open circuit.

At this point I suspected that what ever had failed was the cause of the open circuit. And when I say open circuit there was no reading on my multimeter. As this device has a mixture of surface mount and through-hole components, I had to use a couple of pins on my multimeter to probe for some of the connections.

Tracing the circuit, I found my way through various chokes and filter components, all of which checked out OK. When I started to find various 10MΩ and higher value resistors, I was starting to think this high impedance was normal. I tested several diodes and some transistors but was having no luck at all.

I have a theory, which I call the "black box syndrome", which states that if you do not understand any component, or what it does, then that is the component you are most likely to suspect as being faulty. This, of course, is questionable and really means that if you don't know what the part does, you won't know how to test it and thus eliminate it as a suspect.

I try at all costs not to apply this theory as it is usually wrong but I was staring at a TEA1110AT IC and had no idea what it does; only that it was in the right area.

This is a Philips device, so I got straight onto their website and downloaded the data sheet for this chip. At least I could find out what this device does and work out whether it was causing the problem.

It turned out to be a "Low Voltage Versatile Telephone Transmission Circuit With Dialler Interface". What a mouthful. Still, it sounded like a good culprit. What's more, Audioline appeared to have used a circuit configuration that was very close to that shown in the data sheet.

This IC is powered from the phone line via a bridge rectifier, 10Ω resistor and a 10V zener. With the base station in the stand-by condition, there was no power to the IC but when the hands-free speaker was selected, I had 10V on pin 1 (LN).

There were a couple of transistors controlled by another section of the phone between the bridge rectifier and 10Ω resistor. These were switched in when the base station was off-hook. The data sheet suggested 619Ω between pin 1 and pin 14 (Vcc) but in this case, it was 1kΩ.

When the voltage at pin 14 was measured, there were only a few millivolts. A check to chassis found about 25Ω at pin 14. Maybe there was something in the black box syndrome after all. There were several other components connected to this pin and I wanted to isolate the IC from these components. The IC is a surface mount type, so with the aide of a magnifying lamp I was able to unsolder pin 14 and check the resistance without the IC. This turned out to be 80kΩ or so, so the problem was in the IC.

I phoned several suppliers and soon found that the TEA1110AT is not stocked by anyone I normally deal with. A call to Philips lead me to a few of their agents who either did not want to know me (I'm not a manufacturer) or would only sell me a reel (1170 pieces). The next problem was that there were none in the country. Maybe those other repairers have seen this problem before and knew that the necessary parts were unobtainable.

After making further calls, I eventually found a very helpful lady at Philips who was able to help. As a result, I decided to remove the faulty IC and now have great sympathy for anyone who has to repair devices with surface-mount components. However, I eventually managed to remove it without any damage to the PC board.

With the IC on the bench, I checked each pin and found only 5Ω between pins 14 & 2. Because pin 2 has a 20Ω resistor to chassis, that accounted for my measurement of 25Ω. A look at the internal circuit for the IC suggested that there was a very convoluted path between pin 14 and pin 2. I was feeling confident as there is no way it should be so low, so things were looking good. All I had to do was sit back and wait for the replacement part.

While waiting for the part, I had an opportunity to measure the line resistance of another FF895 and found it to be open circuit (higher than I could measure), so this was the normal condition. When the IC turned up all I had to do was solder it in – sounds easy doesn't it?

I tinned each of the PC board pads, then gently held the device in place with tweezers and tacked one pin, aligned it, then removed it, tacked it again and realigned it! Once in location, soldering the remaining pins wasn't all that difficult but I did spend some time checking each pin with a magnifying glass to make sure I didn't have any solder bridges.

Reassembly involved holding one's mouth correctly to align the circuit board and I have to admit to being relieved that the phone now worked correctly.

Weakest link

I thought the failure was interesting in that the component that failed was not the first stage – there was a lot of hardware in between. The surge had obviously come down the phone line but this phone has various chokes and filters, so it appeared to be well protected. Like all things I suppose, it is always the weakest link that fails. **SC**

Jaycar ELECTRONICS

February SALE

2.4 GHz Wireless Cameras

B&W CMOS Wireless Camera Transmitter/Receiver

Take the hassle out of installing surveillance cameras, simply apply power, and the camera will transmit the image and audio, to the awaiting receiver. It features infra-red LEDs mounted on the front to "See In The Dark". Great for monitoring sleeping children, or the poolside action. Supplied with mains plugpacks, camera, 3 channel receiver, and an A/V RCA cable.
Cat Price $269

SAVE $30

Cat. QC-3255 Introductory Price $239

Colour CCD Wireless Camera Transmitter/Receiver

Monitoring remote locations has never been easier or cheaper with this colour transmitting camera and 3 channel receiver. The receiver will accept up to 3 separate cameras and can be set to scan and individually display each camera. Great for home security, kindergartens, factories, surgeries etc. Supplied is a 3 channel receiver, one transmitting camera, mains plugpacks, and an A/V RCA cable.
Cat Price $329

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Accentuate your displays with these versatile high intensity mini LED spotlights. Ideal for anywhere highlighting is required. Available in Red, Green, Blue and White. Individual units are suction cup mounting (to any smooth surface), and feature a 360° rotation for mounting at any angle. LED Control Module required (Cat. ST-3910) see below.

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The ultimate meter for professionals and serious enthusiasts.

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Includes holster and temperature probe valued at $38

Was $299

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Cat. QM-1290 Now $249.00

Control Module for Waterproof LED Lights

Controls up to 5 spotlights. Supplied with belt clip and double sided tape. Mains plugpack supplied.

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Cat. ST-3910 $24.95

Anti-Static Soldering Station with Free Gifts

goot

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- Deluxe Solder Tip Cleaner
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Simply replace your car windscreen washer units with these. Supplied with wiring loom for LED and mounting hardware. Ideal deterrent for a car alarm when vehicle is parked. We must warn that it is illegal to use them illuminated when vehicle is in motion.

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Cat. MB-3535 $34.95

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These scales will calculate the amount of body fat you are carrying. They can be calibrated for use by 8 different people, and use "bio-impedance-analysis" to measure the body fat ratio.

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Cat. BE-1531 $24.95

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Learn how to set up and maintainence of Solar systems. Covers regulation, inverters, wiring and much more.

Cat. BE-1532 $34.95

Garage Parking Signal

This device uses an Ultrasonic Sensor, and as your car gets closer, the lights activate to indicate the distance remaining between the wall and your car. The unit can be calibrated for custom distance settings.

Requires 4 x D cell batteries. Not supplied.

NEW PRODUCT

Cat. LR-8866 $59.95

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This digital compass is hand held or vehicle windscreen mounting, and supplied with both a lanyard and a suction mount base. The LCD display has an adjustable angle from flat for holding in the hand to vertical for windscreen mounting. It displays the time & temperature in either C or F. Available in black only.

Cat. QM-7262 $59.95

Mini Phone and Microphone Preamplifier

NEW PRODUCT

This unit is a high slew rate op-amp with 5% RIAA equalisation capacitors built onto a small PCB. It will bring a dynamic microphone or magnetic cartridge up to line level with very low distortion characteristics.

Cat. AA-0234 $26.95

Super Hi Fi Bi-FET Preamplifier Module

The preamp module features an independent onboard phono preamp section that can be wired as part of the input switching arrangement to the main preamp. The module has bass, treble and midrange controls, a volume control and provision for a loudness and tone defeat switch

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- THD 0.005% at rated output
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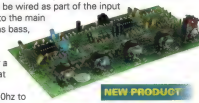

NEW PRODUCT

Cat. AA-0315 $89.95

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Utilising a headset microphone for hands free operation, it is ideal for small PA applications such as in-store demonstrations, tour guides and lecturers etc. An auxiliary input also lets you play music from portable CDs and MP3 players to larger audience. A soft carry pouch with belt loop and waist strap is included.

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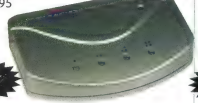

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See cat page 293 for details

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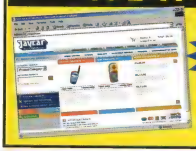

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B&W Dome Camera Product Recall

Jaycar Electronics is recalling all B&W Surveillance Dome Cameras, our Cat. QC-3472 sold between January and August 2002. The units sold during this time do not comply with the EMC Emission Standards. The problem has now been rectified, and customers are asked to return the product to any Jaycar store for over the counter replacement. Please accept our apologies for any inconvenience caused.

RF Modulator for Audio/Video

This modulator converts a Video and Audio signal to an RF or 'Antenna' type signal to connect directly into a TV which only has a TV aerial socket. Channels 0 and 1.

- Requires 12VDC @ 100mA.
- Use Plugpack MP-3002

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4 Channel Colour Quad Processor with Audio and RS-232 Connection

New Product

A professional quality 4 channel processor with audio that will display each camera sequentially or as a split screen image showing all 4 cameras simultaneously. Basic functions can be remotely controlled via an RS-232 serial interface. Features an inbuilt title generator, freeze frame, video loss detection, independent colour/ brightness/ contrast adjustment and much more. Ask in store for details.

Cat. QC-3367 $549

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Incorporates high speed real time compression and digital motion detection. Features include scheduled recording, alarm alert & pre-alarm recording. Surveillance images can be accessed remotely via a LAN, WAN or even the Internet. It can be set to alert a remote PC and send live video of the alarm camera. For more see catalogue page 279. Was $849

Cat. QV-3055 $799 SAVE $50

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Use this USB video grabber to capture video images and store them for later use or view them across your network. The software can be configured to detect movement in certain zones of the camera image and advise you via email when the motion is detected. Supports 320 x 240 @ 30fps

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Cat. QV-3054 $199.95

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Mini Door/Window Alarm

This small alarm module mounts on a window or door and is triggerd by a reed switch/magnet assembly when either a door or window is opened. Mounted in just minutes, once triggered, the incredibly loud siren will sound.

Was $17.95 Save $8

Cat. LA-5004 $9.95

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This self-contained alarm provides an effective warning of entry by way of simple melody. Suited for the home or office. One of twelve different melodies are cycled each time the alarm is triggered. Was $17.95 Save $8

Cat. LA-5006 $9.95

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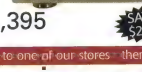
16 Channel Colour Full Duplex Multiplexer



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Wall Mount Step Light

Will mount on a wall so it's great for step or path lighting. Points down so no glare. Suits JC pin globe.

Cat. SL-2778

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GARDEN LIGHTING

Pagoda

Light up the path as well as the surrounding garden. Suits JC pin globe.

Cat. SL-2784

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Includes spike for pushing into the ground. Length 310mm incl spike. Suits MR16 globe.

Cat. SL-2770

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Flushmount Illumination

Designed to be embedded into a path or walkway. Can be walked on. Suits MR16 globe.

Cat. SL-2776

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Pathway Illuminator

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Cat. SL-2780

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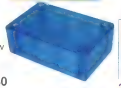

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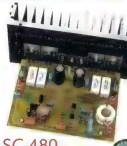

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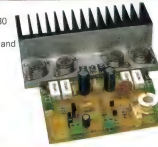

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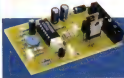

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Building THE SC480

PART 2 – By LEO SIMPSON & PETER SMITH

Putting together our new high performance amplifier modules

Last month, we presented the circuit and performance details of the modules which effectively replace the very popular, but ancient, ETI480 amplifier. This month, we show how to assemble the PC board(s) and connect them for the very best performance.

As discussed last month, there is a choice of two modules; one with plastic power output transistors (Version 1) or with TO-3 metal encapsulated output transistors (Version 2).

At this stage, it is likely that Version 2 will be available from all major kitset suppliers, while at least one supplier has indicated that they will be selling both versions.

Both modules are straightforward to assemble but the transistor mounting details differ considerably between the versions. Therefore, we'll begin by describing the assembly of parts common to both versions.

Common assembly

Before installing any components, check the PC board for defects such as shorted or open-circuit tracks or undrilled holes. Fix any defects before proceeding further.

Referring to the overlay diagram in Fig.1 (for Version 1) or Fig.2 (for Version 2), install the wire links first, using tinned copper wire. Then you can install the resistors, followed by the three diodes.

If not sure of the resistor values, use your multimeter to check each one's value before soldering it in place and make sure that the diodes are installed the right way around. The four 0.22Ω 5W resistors and the 6.8kΩ 0.5W resistor should be mounted about 1mm proud of the PC board surface to improve heat dissipation.

All six small transistors (Q1-Q6) can go in next. There are three different transistor types in this group (BC557, BC639 & BC640), so be particularly careful with placement.

Install the four fuse clips and five 2-way terminal blocks next. Note that the small retaining lug on each clip must be positioned to the outer (fuse end) side, otherwise fuse installation will be impossible. These components must be seated firmly on the PC board surface before soldering.

By now, your board should be starting to take shape! Continue the good work by installing all the capacitors, starting with the smallest devices and working up to the largest.

The two 470µF 50V electrolytics are polarised components and must be installed the right way around. Note also that they're oriented differently to one another. If you get either of them the wrong way around, they will be damaged when power is applied and may even explode.

Just to confuse the issue, there are two other electrolytic capacitors on the board, 1µF and 47µF, and both are non-polarised and can go in either way around. By the way, some manufacturers call these bipolar (BP) and some call them non-polarised (NP). We intend to standardise on the term "NP".

Note that the 68pF ceramic capacitor, between collector and emitter of transistor Q5, must have a rating of 100V. Similarly, the 150nF (0.15µF) capacitor at the output of the amplifier should have a minimum rating of 250V.

Continue construction by installing the multi-turn potentiometer (VR1), 6.8µH choke (L1) and "Polyswitch" thermistor (PTC1).

We understand that some kits may not include the optional Polyswitch thermistor, so install a wire link in its place if necessary.

Winding the choke

If you've building your amp module from a kit, the 6.8µH choke may have been supplied pre-wound. If so, all you'll need to do is scrape the enamel insulation off the wire ends, tin them and solder the part in place.

Alternatively, it's a relatively simple matter to wind the choke yourself. You'll need a 13mm I.D. plastic former (bobbin) and about three metres of 1mm enamelled copper wire.

Begin by bending the wire at right angles, about 10mm from one end. This will be the starting end. Slip it into the bobbin and position the end in one of the slots. Now wind

The two versions of the SC480 amplifier: on the left is what could be called the direct replacement of the ETI-480, with the same TO-3 output transistors (2N3055/2955). Performance, though, is streets ahead. On the right is the "plastic" version using TIP3055/2955 output transistors. These are easier to mount to a heatsink than the TO-3 variety.

on 23.5 turns as evenly and tightly as possible. Pass the remaining wire length out through the opposite slot and cut off any excess, leaving about 10mm protruding.

Wind on a couple of turns of insulation tape to hold everything in place. Scrape the enamel insulation off the wire ends with a scalpel blade or similar and tin with solder.

Don't worry if the result is less than perfect. An extra turn or a small deviation in the wire will have little effect on the performance of your completed module!

With a bit of minor adjustment, the assembly should slip neatly into position in its PC board holes. Press down firmly so that the bobbin contacts the PC board surface and solder in place.

Well, that completes the assembly of the parts common to both versions of the amplifier. Now we'll describe how to mate the power transistors to your chosen heatsink, starting with Version 1.

Mounting the output transistors (Version 1)

As depicted in the various photographs, the four plastic power transistors and three driver transistors all mount along one edge of the PC board. Transistor spacing is arranged so that the assembly will bolt up to many commonly available heatsinks.

Our prototype is shown attached to an Altronics H-0552 heatsink. Other suitable types include the Dick Smith Electronics H-3406 and the Jaycar HH-8546.

To begin, fit 10mm tapped spacers to the two remaining PC board holes using M3 x 6mm screws. Notice how this leaves the PC board sitting in a rather lop-sided attitude, with one side higher than the other. We slipped a second, temporary pair or 10mm spacers under our board to bring it back to the horizontal and therefore make the remaining assembly tasks easier.

Next, fit the seven transistors (Q7-Q13) into their respective holes, but do not solder or cut their leads short just yet!

Butt the assembly up against your chosen heatsink and centre it roughly within the available space.

If you're using one of the heatsinks mentioned above, then you should be able to line up the transistor mounting holes with the spaces between the heatsinks fins. This makes life much easier; there's no need to drill into fins or tap threads in blind holes!

In the horizontal plane, the transistors should be mounted as close to the centre of the heatsink as practical. Obviously, this will be limited by available transistor lead length.

Once you're happy with the positioning, mark off and drill 3mm holes for each of the seven devices. After drilling, remove all burrs from around the holes so that the mounting surface is entirely smooth.

That done, loosely attach the transistors to the heatsink using the mounting hardware shown in Fig.3. Check that the PC board is sitting horizontal and at right angles to the heatsink and tighten up the screws. Flip the assembly over, taking care not to disturb the PC board position, and solder all transistors in place.

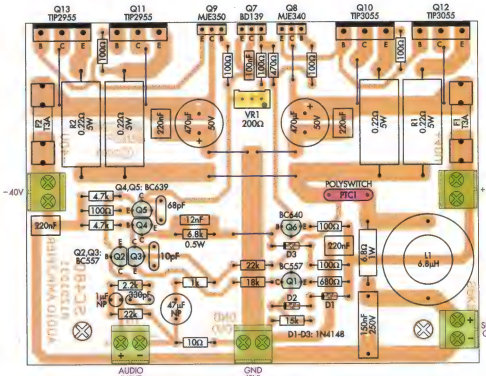
Finally, it's a good idea to make sure that all transistor collectors are indeed isolated from the heatsink. To do this, set your meter to read Ohms and measure between the heatsink and the metal tab (collector) of each TO-218 device. Also, measure between the heatsink and centre lead (collector) of each TO-126 device. You should get a high resistance (open circuit) reading in all cases.

Mounting the output transistors (Version 2)

In most cases, kit suppliers will provide a predrilled heatsink or heatsink bracket with the Version 2 module. However, if you're building yours from scratch, here's how to get all the holes in the right places.

To begin, position the PC board on the smooth side of the heatsink surface. If you're using the recommended heatsink, then the board should be a good fit on the 35mm shelf.

Fig.1: component overlay and matching photo below of the plastic transistor-equipped SC480 amplifier (Version 1). It's very easy to build when you use these to help you. The complete circuit diagram and description were presented in last month's SILICON CHIP. In this version, the transistors can bolt directly to just about any heatsink. It is definitely the easier form of construction.



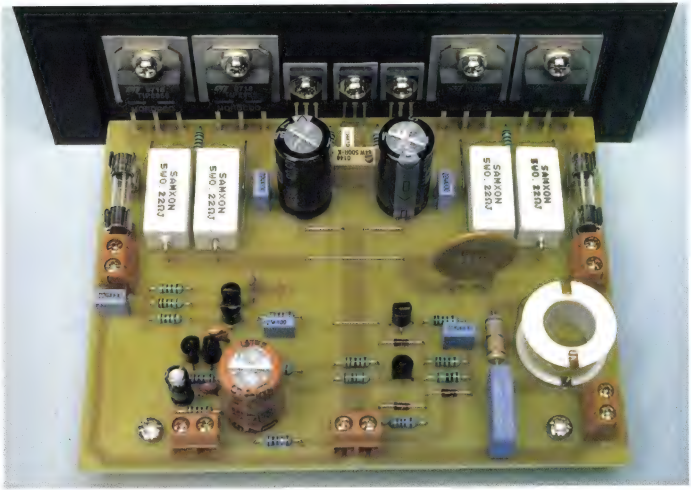
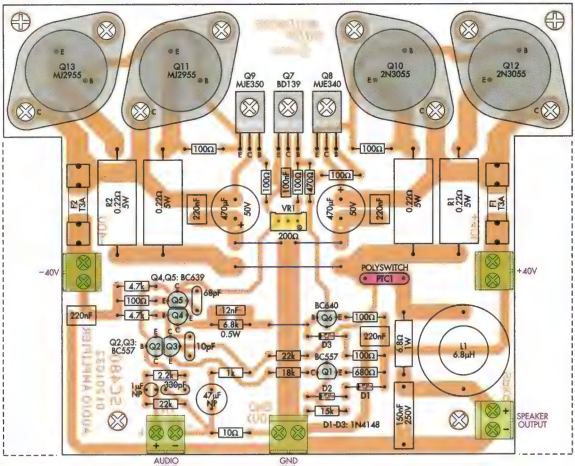
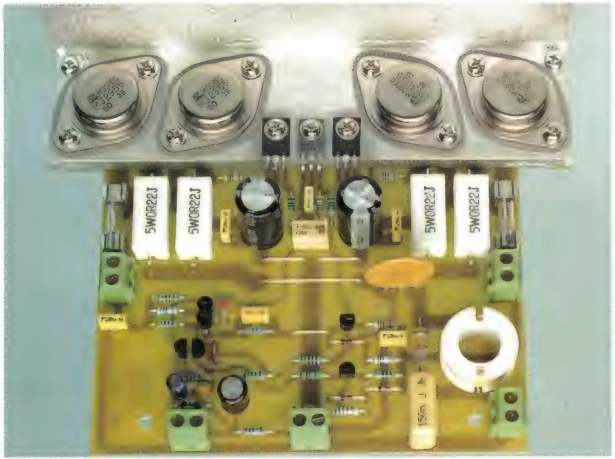


Fig.2: similarly, Version 2 of the SC480 amplifier with TO-3 transistors. While more robust (and also very similar in appearance to the original ETI-480), mounting the TO-3 transistors does require more care and skill in drilling the heatsink. In the ETI-480, the transistors were attached to a bracket which then attached to the heatsink. While a practical alternative, the heat transferrance is not as effective.





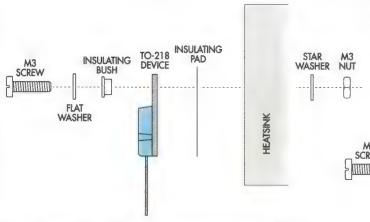


Fig.3a (above): detail showing how the plastic (TO-218) transistors are mounted on the heatsink, with their insulating washers and bushes. Not shown here is the PC board because it does not fasten to the heatsink.

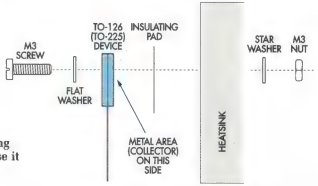
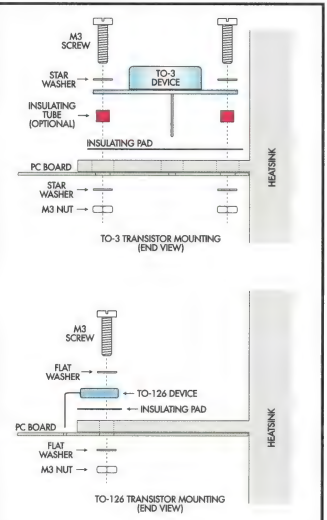


Fig.3b (below): the smaller (TO-126) devices mount in a similar way to the larger transistors but no insulating bush is required as there is no metal tab. The back of the transistor must still be insulated from the heatsink.



Figs.4a (top) and 4b (bottom): here's how the transistors mount to the heatsink (or heatsink bracket) in Version 2. All of the nuts and bolts which hold the transistors on the heatsink also hold the heatsink on the PC board.

Clamp in place and use a sharp scriber or pencil to mark through the holes of all seven transistor positions as well as the two heatsink alignment holes (see overlay diagram). Make sure that you've marked all 21 holes before unclamping the board.

Gently centre-punch your marks before drilling. Start with a small drill size (about 1mm) and work up to the final size in several stages for best results. Note that a drill press is mandatory for this job. Drilling accurate holes in thick aluminium with a hand drill is almost impossible.

The TO-3 transistor holes (four for each device) should be drilled to 6mm. All other holes should be drilled to 3mm. After drilling, remove all burrs from around the holes so that both top and bottom heatsink surfaces are completely smooth.

Note that the holes sizes in the PC board do not match the heatsink hole sizes. This is as intended; do not enlarge the PC board holes!

On the PC board, all transistor mounting holes as well as the two heatsink alignment holes should be precisely 3mm in diameter. In addition, the TO-3 transistor emitter and base lead holes should only be large enough to accept the respective device leads.

OK, let's put it all together.

Position the PC board *beneath* the heatsink shelf and insert the two M3 x 12mm alignment screws through from the top. Fit M3 washers and nuts (on the PC board side) and wind up but don't fully tighten just yet.

Now take a moment to admire your work. Looking through from the top, the PC board holes should be centred within the heatsink holes. If any deviate by more than about a millimetre from centre, then you may have problems. The heatsink holes are sized so that the TO-3 transistor mounting screws can pass right through without making contact. If there is any chance of the screws shorting to the heatsink, then you should consider insulating them with high-temperature tubing or similar.

Assemble the transistors to the heatsink and PC board as shown in Fig.5, starting with the smaller (TO-126) devices. We've recommended nickel-plated brass screws and nuts

Parts List – SC480 Amplifier Module(s)

Parts common to both versions

1 6.8µH air-wound choke (L1) (see text)
1 Raychem RXE250 Polyswitch (IH=2.5A, IT=5A, 60V) (PTC1)
3 TO-126 silicone-impregnated insulating washers
4 M205 PC mount fuse clips
2 M205 3A slow blow fuses

Semiconductors

3 BC557 PNP transistors (Q1-Q3)
2 BC639 NPN transistors (Q4, Q5)
1 BC640 PNP transistor (Q6)
1 BD139 NPN transistor (Q7)
1 MJE340 NPN transistor (Q8)
1 MJE350 PNP transistor (Q9)
3 1N4148 small-signal diodes (D1-D3)

Capacitors

2 470µF 50V PC electrolytic
1 47µF 16V non-polarised (bi-polar) PC electrolytic
1 1µF 16V non-polarised (bi-polar) PC electrolytic
4 220nF (0.22µF) 63V metallised polyester (MKT)
1 150nF (0.15µF) 250V metallised polyester (MKT) (10 or 15mm lead pitch)
1 100nF (0.1µF) 63V metallised polyester (MKT)
1 12nF (.012µF) 63V metallised polyester (MKT)
1 330pF 50V ceramic disc (or plate)
1 68pF 100V ceramic disc (or plate) or polystyrene
1 10pF 50V ceramic disc (or plate)

Resistors (0.25W, 1% unless specified)

2 22kΩ 1 18kΩ 1 15kΩ 2 4.7kΩ 1 2.2kΩ
1 1kΩ 1 680Ω 1 470Ω 8 100Ω 1 10Ω
1 6.8kΩ 0.5W 5%
1 6.8Ω 1W 5%
2 560Ω 5W 5% wire-wound (for calibration, see text)
4 0.22Ω 5W 5% wire-wound
1 200Ω 0.5W 25-turn trimpot (VR1)

Connectors

5 2-way 5.08mm pitch 10A terminal blocks

Miscellaneous

230mm (approx.) 0.7mm tinned copper wire (for links)

Parts specific to Version 1 (plastic)

1 PC board coded 01201031, 119.4mm x 90.2mm
4 TO-218 silicone-impregnated insulating washer sets (with bushes)
1 Heatsink (1.2°C/W or lower) (eg. Altronics H0552)
2 TIP3055 NPN power transistors (Q10, Q12)
2 TIP2955 PNP power transistors (Q11, Q13)
2 M3 x 10mm tapped spacers
2 M3 x 6mm pan head screws
7 M3 x 15mm (or 16mm) pan head screws
7 M3 nuts
7 M3 flat washers
7 M3 star washers

Parts specific to Version 2 (TO-3)

1 PC board coded 01201032, 149.8mm x 118.7mm
4 TO-3 silicone-impregnated insulating washers
1 Heatsink with 35mm flange (eg. Jaycar H-8550)
2 2N3055 NPN power transistors (Q10, Q12)
2 MJ2955 PNP power transistors (Q11, Q13)
2 M3 x 12mm pan head screws
11 M3 x 15mm (or 16mm) pan head screws (nickel-plated brass)
13 M3 nuts (nickel-plated brass)
16 M3 star washers (stainless steel)
8 M3 flat washers

Power Supply

1 PC board coded 01201033, 90.2mm x 54.6mm
4 1N5404 3A power diodes (D1-D4)
2 4700µF 50V PC electrolytic capacitors
1 56V/2.4A centre-tapped mains transformer
2 3-way 5.08mm pitch terminal blocks
4 M3 x 10mm tapped spacers
4 M3 x 6mm pan head screws

Parts for optional preamp supply section

2 15V 1W Zener diodes (ZD1, ZD2)
2 100µF 16V PC electrolytic capacitors
4 2.2kΩ 1W 5% resistors
1 3-way 5.08mm pitch terminal block

(not steel) for securing the TO-3 devices. This gives a measurable, albeit small, performance improvement. Tighten up all screws but don't solder the transistors leads just yet.

Set your meter to read Ohms and measure between the heatsink and the metal can (collector) of each TO-3 device. Also, measure between the heatsink and centre lead (collector) of each TO-126 device. Obviously, you should get a high resistance (open circuit) reading in all cases.

If everything checks out, then solder all transistor leads to complete the assembly.

Of special note here is that the TO-3 transistor mounting screws must be tightened up *before* soldering the base and emitter leads. If this is done in reverse order, then stress will eventually crack the solder joints and perhaps even delaminate the PC board copper.

Heatsink brackets

As mentioned previously, some Version 2 kits will be supplied with pre-drilled heatsink brackets (as was the ETI-480). The assembly details listed above should still apply, with the main difference being that once assembled, the bracket must be bolted to your heatsink of choice.

When attaching a bracket to a heatsink, make sure that you have good mating across the entire facing surfaces, and use heatsink compound to maximise heat transfer.

Power supply assembly

All secondary-side power supply components, apart from the transformer, are contained on a single small PC board, coded 01201033.

Referring to the power supply circuit in Fig.5 and overlay diagram in Fig.6, you can see that the supply incorporates a

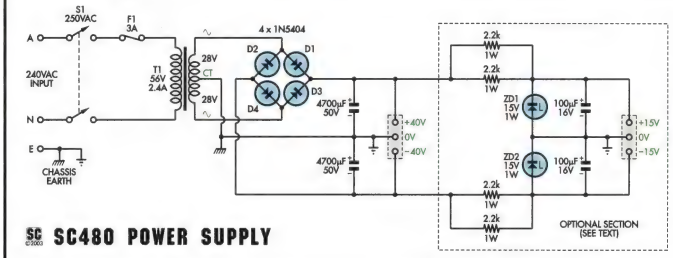


Fig.5: the power supply for the SC480 is simple enough but adequate for the job. As explained in the text, if you don't need a ±15V preamp supply, all components within the dotted box can be left out.

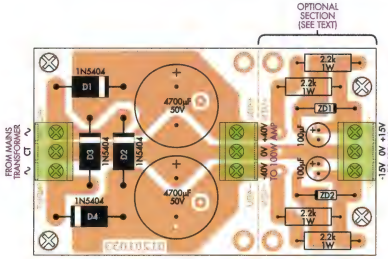
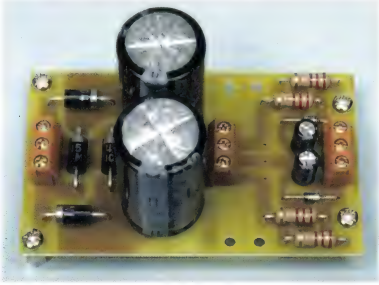


Fig.6: the power supply PC board overlay, again with a matching photo below. This supply suits a single module – if you want to build a stereo amplifier, you will need two supplies (and either two transformers or one rated at around 5A @ 56V AC).



±40V section and an optional, regulated ±15V section. The ±15V supply is handy for those assembling a complete system and can be used to power a preamplifier module, for example.

If you have no need for the low-voltage supply, then there is no need to install the associated components. For added flexibility, we've designed the PC board so that you can cut off the low-voltage end if you so desire.

Begin assembly by fitting an M3 x 10mm tapped spacer to each corner of the PC board. Follow with the four diodes (D1-D4) and two 3-way terminal blocks, making sure that they're seated firmly on the PC board surface before soldering.

Be very careful with the orientation of all of these components, as mistakes here can result in major fireworks at power up.

If required, all components in the optional ±15V section should be installed next. Note the zener diodes (ZD1, ZD2) go in different ways around.

Last of all, install the two 4700µF 50V filter capacitors.

Wiring

Housing and wiring of the amplifier modules is totally up to you. However, we've outlined a few

Insulated TO-126 packages

Transistors Q7-Q9 are manufactured in plastic TO-126 packages that usually include a small rectangular metal area on the rear. This area is electrically connected to the collector and thus must be isolated from the heatsink with an insulating washer (see Figs.4 & 5). However, some packages that we've seen do not have this metal area – they're plastic (epoxy, actually) on both sides. This 'isolated' type package should be mounted without an insulating washer. Simply smear with a small amount of heatsink compound and bolt directly to the heatsink.

important points below that will help you to get the most from your project.

Fig.7 depicts the most important elements of any wiring layout.

Note in particular the position of the +40V & -40V wiring as it passes under the PC board. Positioning the wires exactly as we've shown helps to cancel the fields resulting from currents flowing in the PC board tracks. This produces the lowest possible signal distortion.

To reduce radiated noise and to improve overall appearance, tightly twist the power supply and speaker wires as shown. Use a medium to heavy-gauge multi-strand wire for both of these connections.

Connections to the modules are terminated in 2-way terminal blocks. Only one position (hole) of each of the terminal blocks for the +40V, -40V and 0V (GND) connections should be used.

Do not connect *anything* to the remaining position.

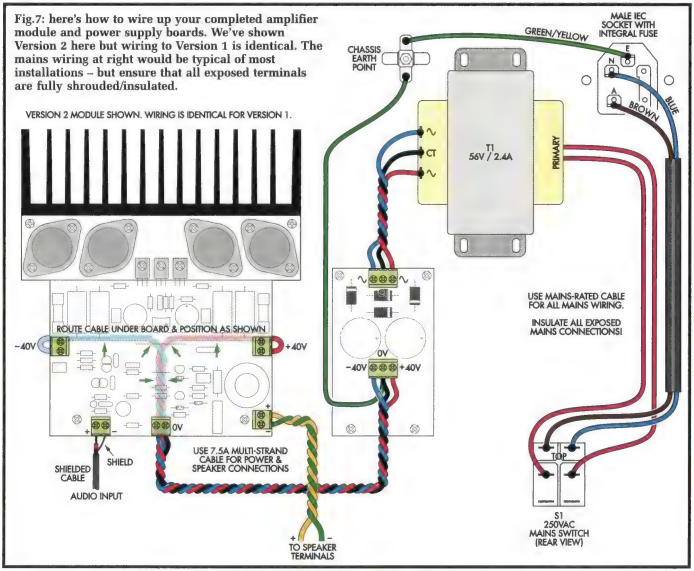
Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑ 2	22kΩ	red red orange brown	red red black red brown
❑ 1	18kΩ	brown grey orange brown	brown grey black red brown
❑ 1	15kΩ	brown green orange brown	brown green black red brown
❑ 1	6.8kΩ	blue grey red brown	blue grey black brown brown
❑ 2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑ 1	2.2kΩ	red red red brown	red red black brown brown
❑ 1	1kΩ	brown black red brown	brown black black brown brown
❑ 1	680Ω	blue grey brown brown	blue grey black black brown
❑ 1	470Ω	yellow violet brown brown	yellow violet black black brown
❑ 8	100Ω	brown black brown brown	brown black black black brown
❑ 1	10Ω	brown black black brown	brown black black gold brown
❑ 1	6.8Ω	blue grey gold brown	blue grey black silver brown

Earthing is one of the most important and perhaps contentious issues in system design. As we've shown in Fig.7, all ground (0V) lines must be returned to a single earth point. If you're building a stereo system, then its ground (0V) line must also be connected to this point.

By the way, you'll need two power supply modules for a stereo setup, as a single module is just not up to the task.

Fig.7: here's how to wire up your completed amplifier module and power supply boards. We've shown Version 2 here but wiring to Version 1 is identical. The mains wiring at right would be typical of most installations – but ensure that all exposed terminals are fully shrouded/insulated.



You'll also need two transformers, although it is possible to upgrade to a single, larger, unit of appropriate capacity.

Setup & testing

No doubt you're keen to try out your new amp. But hold on a minute; there are a couple of checks and adjustments that must be made first!

With nothing connected to the output terminals of the power supply module, apply mains power and measure both positive and negative rails. You readings should be

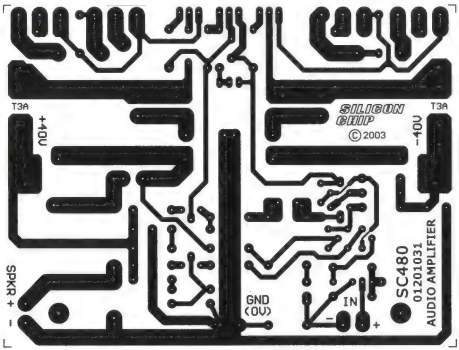


Fig.8: PC board pattern for Version 1, coded 01201031. This board is the smaller of the two, measuring 119 x 90mm compared to the Version 2's 150 x 119mm.

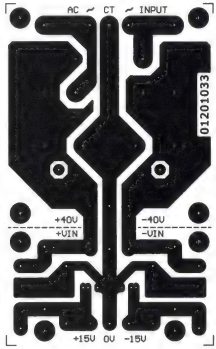


Fig.9: PC board pattern for the power supply (01201033).

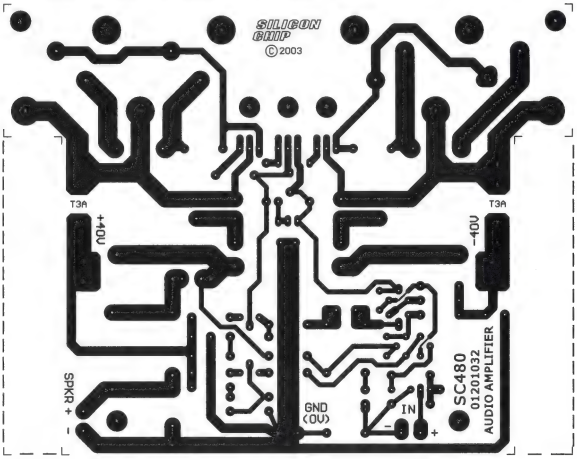


Fig.10: PC board pattern for Version 2, coded 01201032. The "empty" sections of the board on the left and right side (shown dotted) were removed for aesthetic reasons (as our photos also show) but we imagine most kit and board suppliers will leave these sections in place, making it a rectangular (and therefore cheaper) board. Performance-wise, it doesn't matter either way.

close to the 40V mark, depending on mains fluctuations.

A word or two of caution: avoid contact with the ±40V DC supply rails. Although you may get less than a "tingle" from the positive or negative rail, getting yourself across both of them simultaneously could be a shocking experience!

If you have installed the optional ±15V section of the power supply module, then the large filter caps will discharge to a safe level quite quickly at power off.

However, without the low-voltage section, the ±40V rails will decay at a slower rate, so it's wise to check the rails with your meter before touching anything.

OK, the next step is to set the amplifier's quiescent current level. To do this, remove both fuses from the board and solder a 560Ω 5W resistor across each fuse clip pair. You may find it easier to tack solder the resistors on the rear (copper) side of the PC board.

The purpose of the resistors, by the way, is to limit fault current should there be a problem with the board, as well as to simplify current measurement.

Note that nothing should be connected to the input or output terminals until these checks are complete.

Set VR1 fully anticlockwise and then apply power.

Table 2: Capacitor Codes

	Value	IEC Code	EIA Code
❑	220nF	220n	224
❑	150nF	150n	154
❑	100nF	100n	104
❑	12nF	12n	123
❑	330pF	330p	330
❑	68pF	68p	68
❑	10pF	10p	10

With your multimeter set to read 50V or more, measure across one of the resistors and rotate VR1 clockwise until you get a reading of 28V. This gives a total quiescent current of 50mA.

Give the amplifier about 5 minutes to warm up, then readjust if necessary. You'll probably find that the voltage across the other resistor differs by a volt or two; this is normal.

Finally, measure across the output (speaker) terminals. The reading should be within ±30mV of the 0V rail.

Problems?

If you can't adjust VR1 for the correct reading or the output voltage is more than ±30mV, then there is a fault on the board.

We've provided voltage readings for various points in the circuit (see Fig.10, part 1 [SILICON CHIP January 2003]) that may help you to track down the problem. Your readings should fall within ±10% of our listed values.

Once everything checks out OK, switch off power, remove the resistors and plug in the fuses. You're ready to rock! **SC**

Book Review: Motor Home Electrics & Caravans Too!, by Collyn Rivers.

Self-published 2002. Spiral bound, 296 x 210mm, 102 pages. ISBN 0 9578965 14. $42.50

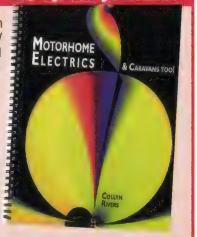
Anyone who has been an electronics enthusiast over the past 30 years or so will be well aware of Collyn Rivers. He was the founding editor of "Electronics Today International" (ETI) magazine which went on to have a number of very successful editions in the UK and elsewhere, as well as being very successful in Australia. With that sort of background you can expect that he has put together a comprehensive but succinct guide to caravan electrics.

The subject is not rocket science but there are a lot of myths and wrong information afield and Collyn has done a good job of setting the record straight.

There are 30 chapters in all, plus four appendices. Collyn starts out by defining the essence of the problem – storing and extracting the maximum amount of energy from lead acid batteries, while ensuring that they give as many years of use as possible. The problems are the same whether you are running a solar-powered home in a remote location, a motor home, caravan or boat. Collyn also goes on to discuss alternators, voltage regulators, solar panels, wind generators and regulators.

The book also defines how much power typical appliances require – far more than most people expect – and devotes a chapter to 240V inverters.

A short (one-page) chapter is devoted to lighting and compact fluorescents and 12V halogen lamps are the recommended types. And while I found that I agreed with all the rest of the book, I disagree with a number of points in this chapter. First, it states that 12V halogens are intended to run on AC – ideally at 11.8V. Supposedly their life is reduced by 50 – 80% if run on DC. This flies in the face of evidence to contrary. Car headlamps have always run on 12V DC and their life is excellent – usually lasting for the life of the vehicle. Secondly, the book recommends the use of a 12V-to-240V inverter to run 12V transformer-driven halogen lamps. "Their 11.8V output extends globe life and reduces consumption, making up for the converter's 5-10% loss". Well, not in my book! Typical inverters are around 70% (or less) efficient and typical 12V halogen light transformers are notorious for running hot and would be unlikely to run at more than 75% efficiency. Multiply the two efficiencies together and the result is that almost 50% of your battery power is lost if you take this inverter/transformer drive approach. In my opinion, you're better off sticking with battery power to run 12V halogens.



However, the chapter is redeemed by a recommendation against halogens and plumping instead for warm white compact fluorescents. Here again, for mobile home use, I would suggest the much brighter "cool white".

Other very useful chapters are devoted to refrigerators, water pumps, electric toilets, TV antennas, communications, low voltage and mains voltage wiring. Perhaps the most useful is the chapter entitled "Suggested solutions" which gives good information on real setups.

All told, this is a very practical and informative book, written in an informal style which is very easy to read.

To purchase the book, contact the publisher, Collyn Rivers, PO Box 3634, Broome, WA 6725. Phone 08 9192 5961. Email: collynr@bigpond.com.au (L.D.S.)

PRODUCT SHOWCASE

Free on-line controller programming course

SPLat Controls is an Australian manufacturer of programmable controllers. They have a very large website, with product information, technical documentation and other support materials for their world-wide customer base.

One of SPLat's significant online resources is a free interactive training course covering the programming of real-world controller applications. The course will take you 10-25 hours to complete depending on your prior knowledge. When you have completed the course you will have acquired the following skills:

* The ability to understand and identify inputs and outputs.
* Understanding the workings of sequential program functions, with programmed decision made through testing and branching.
* The ability to define and analyse a moderately complex control requirement and define a solution in diagrammatic form.
* The ability to translate the diagrammatic solution into a programming language.
* Using timeouts for fault detection.
* Counting off events and actions.
* Programming Boolean (logical) functions.
* Program debugging.
* Good programming practice.

The course is easy to follow, with lots of explanations and examples. It is used by a number of educational institutions in Australia and overseas, including RMIT Universtity but requires absolutely no prior skills other than a logical mind. You will benefit from it even if you are not planning to use SPLat in the near future.

You can run the course on-line or download the files and run it off-line.

You can access the course by going to the SPLat website at sc2.splatco.com .au then selecting "Support" and "Online training" from the menu.

Contact:
SPLat Controls
2/12 Peninsular Boulevarde,
Seaford Vic 3198
Ph: (03) 9773 5082
website: sc2.splatco.com.au

One of these was just about to be a project . . .

Do you curse the designer of your computer for putting all the inputs and outputs on the rear panel?

Thought so! If you're anything like us, you're continually pulling the PC out of its space or fossicking around under or behind desks to access USB ports, sound card ins & outs, game ports, etc.

A few months ago someone here came up with the scathingly brilliant idea of a simple project which brought those sockets – and maybe a few others – out to a plate on the front panel which occupied an unused drive bay.

Time goes by, as time does – and then the January issue of SILICON CHIP came out with a Jaycar advertisement featuring . . . a "Multi-Function Transfer Panel for PCs", which "transfers the USB, firewire, audio line in/out and an infrared IrDA connection" to a plate which occupies an unused drive bay space on the front panel . . .

And just for good measure, the Jaycar model (XC5171) also includes a temperature probe to let you know

how things are cooking inside your PC case.

Aah well, there goes a project . . .

One of the most difficult hurdles we had to overcome in our project was sourcing all the input and output plugs and connectors – but the Jaycar unit includes all of these, along with any mounting hardware required.

At a recommended retail price of $99.95, we reckon it's great value and will save hours of poking around.

And in this issue, it's on special at just $79.95 – sensational value!

Contact:
Jaycar Electronics
PO Box 6424, Silverwater NSW 1811
Ph: (02) 9741 8555 Fax: (02) 9741 8500
website: www.jaycar.com.au

World's first Wi-Fi and Flash Memory Cards

SanDisk Corporation has introduced a line of wireless Wi-Fi (802.11b) cards with the world's first card products to include both memory and wireless communications technology at the Las Vegas Consumer Electronics Show.

The "Connect" product line includes four products – dual-function 128MB CompactFlash (CF) and 256MB SD cards that combine Wi-Fi and flash memory as well as single-function CF and SD cards with Wi-Fi connectivity. SanDisk plans to add 256MB cards to the CF Connect product line by the middle of 2003.

Retail prices are between $US99 and $US149.

Contact:
Sandisk
140 Caspian Ct Sunnyvale, CA 9408
Ph: (00111)408 542 0500
website: www.sandisk.com

Yokogawa ScopeCorder

Yokogawa's new DL750 is the latest in the DL700 series of waveform measuring instruments that can be used for observing a wide variety of waveforms from physical to electric signals. The DL750 ScopeCorder has incorporated 1 gigaword of memory, the largest for this class of device, and is half the size of previous generation products. It is also equipped with the GIGAZoom function, which uses a specially developed ASIC to instantaneously display data stored in the large memory.

The DL750 ScopeCorder can act as an oscilloscope for capturing instant events, as well as a data recorder for prolonged trend measurement.

Control of the DL750 can be done by Wirepuller software – downloadable from Yokogawa's web site – while complete data analysis including waveform analysis, cursor functions, file conversion to ASCII format, etc, can be performed by the Waveform Viewer software.

Contact:
Yokogawa Australia Pty Ltd
Private Mail Bag 24,
PO North Ryde NSW 1670
Ph: (02) 9805 0699
website: www.yokogawa.com.au

USB Print Server from Microgram

USB and NT4 don't mix??

They do now. If you need to connect a USB printer to an NT4 network, all you need is Microgram's new USB printer server.

It will host two USB printers and one parallel printer and simply connects by attaching a UTP cable to the nearest hub.

It supports pretty well everything, including Windows 95/98/98SE/ME/NT 4.0/2000/XP, Mac OS 8.1 or higher, UNIX/Linux, NetWare (Bindery/NDS).

Contact:
Microgram Computers
Ph: (02) 4389 8444
website: www.microgram.com.au

New Gadget Central Store

Where do you get a ballpoint pen that doubles as a head massager? Or a motorised Pepper Mill? Not to mention James-Bond style pens with lasers in them... All this and over 1000 more products can be found at Sydney's newest "must see" Gadget shop.

Gadget Central specialises in providing that unique gift for the person who "has everything" or loves to be the first kid on the block with the new toy. Prices range from $5 to $300 so all budgets are catered for.

Now what about a pair of spectacles that bend your vision by 90° so you can watch TV while lying flat on your back, or a spring loaded fly swatter that really works?

Gadget Central Stores are located at –
225 Macquarie St, Liverpool;
314 Victoria Ave, Chatswood;
95 Burwood Rd, Burwood.

Psst . . . wanna copy some DVDs?

Verbatim Australia have recently updated their range of CopySmartPlus manual-load DVD copiers.

Using a high-speed Pioneer DVD-R drive capable of recording at 4x DVD-R, 2x DVD-RW and 16x CD-R, the towers can copy from and record 3, 5 or 7 new discs depending on the model. A feature of the CopySmartPlus range is their ease-of-use. Note that they will not duplicate copyrighted discs (such as movies).

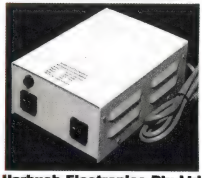
Up to 28 4.7GB DVDs can be produced per hour and the stand-alone towers do not need a PC to drive them.

Priced between $5000 and $10000 depending on model, they are built in Australia by Verbatim.

Contact:
Verbatim Australia
Ph: (03) 9823 0905
website: www.verbatim.com.au

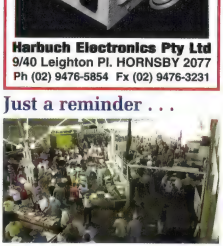
STEPDOWN TRANSFORMERS

60VA to 3KVA encased toroids



Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

Just a reminder . . .



On Sunday 23rd February 2003 the Central Coast Amateur Radio Club hosts the Southern Hemisphere's largest amateur radio and communications show, the Central Coast Field Day.

More than 2000 people from 40 clubs and organisation from all over Australia and the Pacific will converge on Wyong Racecourse to display and trade the latest radio communications equipment.

Plenty of off-street parking is available within Wyong Racecourse grounds. Tea, coffee and biscuits will be available from 8.30 am to 3.00 pm at no charge in the Dining Room. Hot and cold food can also be purchased within Wyong Racecourse.

Gates to the Racecourse will be open to the public from 8.30am Entrance fee: adults $10.00, seniors card, pensioner concession, students $5.00, children under 12 free.

Anyone with an interest in radio communications or electronics can contact the event organisers, The Central Coast Amateur Radio Club, by phoning 02 43402500 for more information. There is an extensive and informative web site covering the Field Day at www.ccarc.org.au

We aim to provide as much information as possible in our catalogue and via phone or email before you make your purchase. But in the event the product doesn't suit your needs, dont worry! Return it to us within 14 days and we'll give you a full refund!

Jack O'Donnell,
Managing Director

HI-POWER AMPLIFIER

2 x 60W, TYRANT car amplifier. Deck out your car with one of these fantastic amplifiers today, featuring;

* *2 Channel (2 x 60W RMS)*
* *Minimal distortion, exceptional frequency response*
* *Anti theft design with removable and caps*
* *High and low level inputs*
* *Variable crossover*
* *Bridgeable*

$199
C 9241 2x60W Was $209

1 FARAD CAP

Plus 5M of heavy duty 4G cable to boot. A huge capacitor like this is vital to keep power flowing to audio components under high loads. **Was $209**

$175
C 9650S

3 Way Car Speakers

6 x 9 250W, Titanium GUNMETAL line. *The all in one approach to car audio! With infinite baffle optimised bass driver, featuring multilayered voice coil and long throw acoustic design. 65mm midrange and 25mm tweeter for crisp highs. Rated at 250W max. 4Ω impedance, 88W RMS, 60Hz-18kHz.*

Introductory Price BE QUICK OR YOU WILL MISS OUT!

$79
C 9366 Was $99

UHF Learning Remote

This learning remote can be used to combine several remotes or replace an old broken one. Suits things like garage doors, car or bike alarms, home alarm, etc. Wide operating freq. 260-500MHz

*Not suitable for code-hopping alarms

$30
A 1015 Was $41.95

Don't pay up to $40 elsewhere!

USB 2.0 Hub!

The new high speed transfer standard is USB 2.0! Fully compatible with older USB devices as well as the new high speed devices. Transfer data at up to 480Mbps across 4 ports. Stylish clear acrylic case. Plugpack supplied.

$79
D 2352 Was $89

ADSL Line Filter

This unit filters out the high frequency tones used by ADSL modems. Any telephone equipment connected to the same line as the ADSL modem requires a filter between the device and the line. No power required. RJ11 socket to 605 plug. ACA approved

$19.50
P 7150

Car Stereo Projects Book

20 complete car stereo projects for just about every type of car! Easy to follow step by step construction with helpful diagrams, photo's and tips. Ideal for ANY car audio buff.

$57
B 2423 Was $62

Thunderous Sub Woofers

C 3030 12 inch: One of our most popular subwoofers ever! Produces deep thumping resonant bass frequencies, perfect for car audio installations, home theatre subwoofers etc.. **Power:** 80W RMS, **Impedance:** 8Ω, **Freq. Response:** 25Hz-3KHz

$145
C 3030 Was $165

C 3033 15 inch: All new model! Fantastic for both home or car applications where an 8Ω subwoofer is required. Produces deep thundering bass from a huge 15 inches of cone area. Build one into a coffee table for some major hi-fi bass! **Power:** 150W Max, **Impedance:** 8Ω, **Freq. Resp:** 28Hz-1.5KHz

$160
C 3033 Was $179

180W Subwoofer Module

This 180W sub-woofer amplifier will enhance your existing sound system and add a touch of realism to home theatre sound systems. HUGE BASS levels that will amaze your mates! Fully self contained the module is ideal for building into custom subwoofer cabinets. Fully featured, **JUST LIKE THE EXPENSIVE HI-FI STORE SUBWOOFERS**,with volume, crossover frequency control, phase switch, high and low level outputs. **Was $269**

$225
A 2451

Features: • Auto Power On/Off with signal presence • Compact modular design • High and Low Level Inputs • High Level Outputs • Volume Control • Short Circuit Output Protection • Active Crossover variable from 50Hz - 150Hz • Phase Correction Switch • Power On Indicator • 240V Operation

Digi Hygrometer & Thermometer

Features: • Large LCD • 12/24 hour clock • Internal /External temperature sensor • Humidity • Backlighting • 4 mode temperature alert (audible alarm), within range, out of range, high and low temp • -50°C to +70°C • Max/Min memory • Sensor waterproof to 3m

$40.00
A 0156 Was $47.50

Ideal for fish tanks, home brew kits, cellars!

16 in 1 LCD Learning Remote

Utilising the latest technology, the A 0990 can replace up to 16 remote controls for your audio visual devices. Preset with many remote control codes, setting up is easy as entering just 4 digits in most cases!

Features: Touch sensitive backlit screen • Preprogrammed with popular remote control codes • Ability to learn remote control codes • Simple to setup and use • 7 Feature buttons for frequently used functions • Custom device labels and layout • Macro • Windows® Software incl.

Replace all of your regular remotes with just one!

$269
A 0990

10 in 1 LCD Learning Remote

Replace up to 10 remote controls with just ONE!

Loaded with features, the A 0993 can be setup to mimic most audio visual devices and some air–conditioning remote controls. Using the Windows® software and PC interface, it is possible to setup the entire remote on your computer and then save it to the remote.

Features: Touch sensitive backlit screen • Ability to learn remote control codes • Simple to setup and use • Macro • 8 Feature buttons for frequently used functions • Flash memory • Clock/Calendar • Custom layout • PC interface

$369
A 0993 Was $399

Career in Electronics

Sydney • Melbourne • Perth
Junior Wholesale Sales

Altronics is looking for some bright electronic enthusiasts to fill junior positions in the above locations. Training will be provided for the successful applicants with the opportunity to progress within the company.

You will be required to perform general administration, sales and warehouse tasks. You must possess an interest in electronics and a youthful, energetic disposition.

If you feel you have the required qualities and are ready to join our dynamic team, please register your interest:

Sydney:	Melb:	Perth:
Peter Deeb	Paul Zervaas	Dean Stephens

Phone: 1300 780 999

Mini 19 Range DMM

with Square Wave Output

Small enough to literally fit in your pocket, this DMM is great for the mobile serviceman or student lab kit. Features square wave output and backlighting!

- DCV to 600V
- ACV to 600V
- DCA to 10A • Resistance to 2000kΩ • Logic Test • Continuity Buzzer • Transistor Hfe
- Data Hold.

See our 2002/03 cat. page 85 for full specs.

FEATURE PACKED!

$25.50
Q 1124 Was $30.95

Anti-Static Mat

Don't risk expensive IC's!

A high quality, rugged, anti-static mat with 2 tool pouches and wrist strap. Also features a double jack so another wrist strap can be plugged in. *Dimensions: 600 x 650mm*

$29.95
T 4030 Was $44.95

Press 'n' Peel PCB Film

Ideal for making your own projects!

Easy as 1,2,3:

1. Photocopy/Laser print
2. Iron onto PCB
3. Etch your board!

Pack of 5 A4 sheets. **Was $34.95**

$31.50
H 0770

19 Range DMM

with Hold Function

3.5 digit multimeter with hFE transistor and diode test functions. Offers the features of expensive meters at a fraction of the cost.

Features:

- Data hold function
- Low battery indicator
- Continuity test
- Current & voltage measurement
- Diode and transistor test

$15.00
Q 1121 Was $19.95

A/V Modulator

NEW Model!

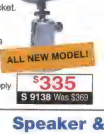
Ideal for connecting CCD camera's or new AV devices such as game consoles, DVD players etc. to older televisions. AV, RF and power input cables provided. Requires 12VDC 300mA supply (M 9271 $14.85) Can be set to VHF channel 0 or 1.

$25.50
S 9231 Was $29.95

Colour IR Camera

Compact, durable and fully sealed CCD camera. Ideal for use outdoors or in variable light conditions. Supplied with adjustable bracket.

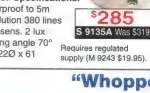
Specifications:
Waterproof to 2m
Resolution 380 lines
Light sens. 2 lux
Viewing angle 70°
Size 36Ø x 48
Requires regulated supply (M 9243 $19.95).



ALL NEW MODEL!

$335
S 9138 Was $369

Colour BULLET CCD Camera



Compact, durable and fully sealed. Ideal for use outdoors or in water prone areas. Supplied with adjustable bracket. **Specifications:**
Waterproof to 5m
Resolution 380 lines
Light sens. 2 lux
Viewing angle 70°
Size 22Ø x 61

$285
S 9135A Was $319

Requires regulated supply (M 9243 $19.95).

Colour Mini CCD Camera

Housed in a sturdy metal housing incorporating a SHARP® sensor and inbuilt microphone.

Specifications:
Resolution 330 lines
Light sens. 3 lux
Viewing angle 70°
Size 31 x 31
Requires 9V supply (M 9236 $14.85)

$195
S 9052 Was $219

60W Soldering Station

An excellent multi purpose soldering iron. Ideal for service techs, engineers, production work etc. Fantastic slim line iron handle, comfortable enough to use for hours and hours! Also available in SMD model (T 2390).

NEW

$149
T 2442 Was $169

Features: • Ceramic heating element • Rapid heat-up & heat recovery • Heater insulation of over 100MΩ • Zero voltage circuit prevents damage to sensitive devices • Continuous temperature adjustable from 250° to 450°C

Speaker & TV Mounting Brackets

H 8060: Speaker mounting brackets for hi-fi or PA use. Base is adjustable from 165-300mm and can hold up to 10kg. Angles 20° vertically and 180° horizontally.

H 8105: TV mounting bracket, holds up to 30kg, 300 x 280mm base plate.

$31.50
H 8060 Was $35

$41.50
H 8105 Was $47.25

"Whopper" Wire

Flat style oxygen free cable for superior sound & low noise. Ideal for hooking up your hi-fi system.102/0.12 strand. Flat style allows easy installation.

50m minimum at this price.

Over 35%-off!

$1.00/m
W 2140 Was $1.60/m

Multimedia Headset

Lightweight headset fitted with in-line volume control, adjustable padded headband and leatherette earpads. Fitted with 1.8m lead and 3.5mm stereo jack. Ideal for internet or multimedia applications. Electret microphone.

Great for internet phone calls!

$25.00
C 9024 Was $29.95

Flameless Heatgun

Reduces heatshrink quickly and easily without burning it. Also great for bending plastics or anywhere a flameless heat application is required.

Features:
• Piezo ignition • 750°C max temp • 20ml gas tank • Refillable • All metal gas feed mechanisms • Handy bench stand • Deflector attachment for easy cable loom heatshrinking.

Quality IRODA product with 12 month replacement warranty

$79.00
T 2479 Was $89

Handy Toolkit

Tools for hobbyists, on site service techs or enthusiasts

Includes:
- Side cutters
- Long nose pliers
- 6 Jeweller screwdrivers
- Tweezers
- Handle plus extension bar
- 4 Sockets, 7, 8, 9 & 10mm
- 9 bits, 2 Phillips, 2 Slotted and 5 star.

All housed in a plastic fold up case.

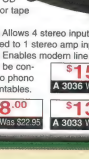
$18.00
T 2170 Was $20.95

Audio Switchers

A 3033: Allows a single amplifier input to be switched between 2 line level sources such as CD players or tape decks.

A 3036: Allows 4 stereo inputs to be connected to 1 stereo amp input.

A 3050: Enables modern line level amps to be connected to phono level turntables.

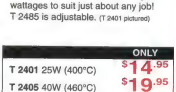


$15.00
A 3036 Was $19.95

$18.00
A 3050 Was $22.95

$13.00
A 3033 Was $16.95

Supa-Value Soldering Irons!



NEW

New release from Altronics!

Perfect range of soldering irons for enthusiast, student or occasional electronic handyman! Wide range of wattages to suit just about any job! T 2485 is adjustable. (T 2401 pictured)

	ONLY
T 2401 25W (400°C)	$14.95
T 2405 40W (460°C)	$19.95
T 2409 60W (520°C)	$22.95
T 2485 30W (250-450°C)	$49.95

■ EXPRESS
Overnight Delivery!*

■ NO RISK
14 day money back guarantee†

ALTRONICS

DON'T BECOME A CRIME STATISTIC!

PIR Detector

WITH DUAL OUTPUTS

SAVE OVER 35%!

The dual relay output is ideal for triggering a VCR as well as the alarm system when an intruder is detected.

Features:
Excellent RFI Immunity
• White light Immunity
• Insect-proof housing
• Temperature compensation
• Self-testing software • Tamper protection • **Dual relay output**
• Includes unique corner mount mounting bracket • Adjustable coverage area

$40.00
S 5307 Was $62.95

State-of-the-art Digital Signal Analysis virtually eliminates false triggering!

6 Zone Home/Business Alarm System

At last a quality professional alarm system at an affordable price!
This 6 zone system is ideal for most suburban homes. It is supplied in 2 parts. The main controller which consists of a lockable steel cabinet housing the main board, power supply, backup battery and field wiring connections. And the modern design remote keypad for entry ways. This controls the entire alarm system from a remote point. **SAVE A TOTAL OF $89.10!**

By far the easiest alarm system to program that we've ever stocked!

AEI

$220
S 5260 Was $280

Features: • Separate keypad and control units • Programmable master code, client code and 6 user codes • 6 zones • Full memory of alarm events • Provision for 3 keypads • Connection for remote siren and strobe • Battery backup option • 12 month warranty.

BONUS OFFER
Every S 5260 Includes a free S 5075 backup battery and M 5325 Plugpack (Valued at $49.10).

CCTV Monitor Sale

Security monitors are the ideal way to keep a constant eye on your home or business. They can be easily hooked up to other security accessories such as quad processors, switchers and multiplexers.
S 9090 is a 2 channel switching unit with a 6 inch screen.
S 9093 is a single channel unit with a 10" screen.
S 9095 is a 4 channel switching unit with a 12" screen.

S 9090

S 9093

S 9095

ALL MODELS ARE B&W

	Was	NOW
S 9090 6" 2 Channel	$129.50	$100
S 9093 10" 1 Channel	$199.00	$169
S 9095 12" 4 Channel	$299.00	$260

Multi-Power Supply Kit

(SC 'April 2002)
An inexpensive, but very flexible bench top power supply. Ideal for R&D
Features: Six selectable steps- ±3.5 ,6 ,9, 12 & 15V DC • Use 9-15V range at the same time as 3-6V range
• Independent load switching • Regulated rails

$89.95
K 3200

Camera Switcher Kit

(SC June '01)
A 4 way audio / video switching unit allows one monitor to switch between up to 4 cameras.

$75.00
K 5842 Was $88.95

Features: • Variable switch rate Channel indicators • Pause button • Audio & video inputs • 9 -12VDC operation

Altronics Kits feature:
- **Solder masked PCB's**
- **Silkscreened to aid construction (on larger PCB's)**
- **Pre-punched and screened panels!**

Digi Thermometer Kit

(SC August '02)
Provides temp measurement from -20°C to 1300°C. Features:
• Under/over temp alarm
• Thermostatic control provision
• High resolution and accuracy
• Plugpack or battery operation
• LCD readout • K Type temp probe.

$99.95
K 6110

70W Amplifier Kit

(SC March 2002)
Based on a Philips TDA1562Q IC, this compact amp module can deliver 70W max (36W RMS) into 4 ohms
Features: 12V DC power input
• Frequency response 28Hz to 55kHz
• Low distortion, typically 0.2% • Easy to build

$48.00
K 5140 Was $59.95

Headphone Amplifier Kit

(SC May 2002)
A great line level amp kit for headphones.
Crank up the volume on your PC sound card or listen to DVD/CD's at the sound level you prefer.

$19.95
K 5506

"Knight Rider" LED Kit

(SC May '02) Create amazing visual effects with this 32 LED chaser. Mount one in a speaker enclosure behind some perspex to spruce up your car audio! Features 12 patterns, adjustable speed and adjustable brightness. Requires 12V DC supply.

$39.00
K 5815 Was $44.95

Battery Guardian Kit

(SC May 2002) Stop your car fridge from running your battery flat.
Features: 10A rating • Low power consumption • Cutout alarm • LED indication of cutout • Automatically re-connects battery power

$47.95
K 4080

ALTRONICS

Phone 1-300 797 007, Fax 1-300 789 777
MAIL ORDERS C/- P.O. Box 8350 Perth Business Centre, W.A. 6849
Altronics Retail Store: 174 Roe St. Perth W.A. 6000

WA

PERTH	Altronics	1-300 797 007
KELMSCOTT	Electronix Mart	(08) 94954433
ALBANY	Leading Edge Hi-Fi	(08) 98410077
BUNBURY	Leading Edge Hi-Fi	(08) 97216222
ESPERANCE	Esperance Comm.	(08) 90713344

QLD

BRISBANE	Dalsound PL	(07) 38396155
BOWEN HILLS	Prime Electronic Comp.	(07) 32527466
UNDERWOOD	David Hall Electronics	(07) 38082777
SOUTHPORT	Prime Electronic Comp.	(07) 55312666
CAIRNS	Pentacom	(07) 40321710
MACKAY	Stevens Electronics	(07) 49512246
ROCKHAMPTON	Access Electronics	(07) 49221066
LONGREACH	Access Electronics	(07) 46580500
CLONCURRY	Access Electronics	(07) 47422590
HERVEY BAY	Keller Electronics	(07) 41283066
MARDOOCH/DORE	All Electronic Supplies	(07) 54436119
MOUNT ISA	Outback Electronics	(07) 47433475
MARYBOROUGH	Keller Electronics	(07) 41214559
TOWNSVILLE	Solex	(07) 47754522

VIC

MELBOURNE	TECS	1300 658 327
BLACKBURN	TECS	(03) 98777071
CLAYTON	TECS	(03) 95626501
COBURG	TECS	(03) 93837511
CROYDON	Truscott Electronics	(03) 97233860
DANDENONG	V & P Electronics	(03) 97064337
HUNTINGDALE	Rockby Electronics	(03) 95628559
NUNAWADING	Semtronics	(03) 98733555
PRESTON	Preston Electronics	(03) 94840191
ROWVILLE	Supplytronics	(03) 97645011
BALLARAT	Wiltronics	(03) 53342513
BENDIGO	PCB Electronics	(03) 54440044
GEELONG	Academy TV	(03) 52481821
WODONGA	Exact Computers & Electronics	(02) 60565746
WONTHAGGI	Raneye Pty Ltd	(03) 56724774

NT

ALICE SPRINGS	Central Communications	(08) 89522388

TAS

HOBART	Active Electronics	(03) 62310111
LAUNCESTON	Active Electronics	(03) 63347333

SA

ADELAIDE	Aztronics	(08) 82126212
BRIGHTON	Force Electronics	(08) 83770512
ENFIELD	Aztronics	(08) 83496340
HOLDEN HILL	Force Electronics	(08) 82617088
WOODVILLE STH.	Force Electronics	(08) 83471188
PORT LINCOLN	Bassham's TV & Comp.	(08) 86830075

NSW

SYDNEY	David Reid Elect.	(02) 92671365
FLEMINGTON	Prime Electronic Comp.	(02) 97461211
SMITHFIELD	Chantronics	(02) 96097218
VILLAWOOD	Superb Electronics	(02) 97557666
NOWRA	Haven Electronics	(02) 44215552
GUNNEDAH	Protronics	(02) 67422110
NEWCASTLE	PDC Group Pty Ltd.	(02) 49562522
PORT MACQUARIE	John Fettell 2-Way Radio	(02) 65811341
WOLLONGONG	Nemec Electronics	(02) 42271620
	Vimcom Electronics	(02) 42284400

NEW ZEALAND

CHRISTCHURCH	Elstronics	+64 3343 4475

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If you are dissatisfied with our goods for any reason return to us in original condition for a full refund (less transportation). All items being returned must be in new condition with all packaging and instructions. All orders will be sent via Australia Post unless otherwise requested. Some items are heavy and require freight. Altronics does not accept responsibility for any damage or loss caused by the transportation of goods. Please allow 7-14 days for delivery. Please add $5 per kit for postage and handling. Express post available at extra cost. Minimum charge for credit card orders $20. Overseas customers please add freight as quoted. Allow 4-6 weeks for surface delivery. Airmail rates on application. Please check availability of back issues before ordering.

Using Linux to Share an Optus Cable Modem Internet Connection

Pt.4: firewall logs, operating without a keyboard or monitor & automatic shutdowns

In this final article, there's a useful script file to enable easy viewing of the firewall log plus further advice on Internet security. We also describe how you can operate your Linux box without a keyboard or monitor and shut the system down correctly just by pressing the power switch!

By JOHN BAGSTER

A USEFUL SCRIPT FILE I wrote called ***zplog*** is available for free download from the SILICON CHIP website. In case you're wondering where the name came from, I have convention of starting all my programs and scripts with "z" so I know that they are "home grown" (not many commercial programs start with "z"). The "plog" bit stands for "packet log".

I will not attempt to explain how it works as it contains a lot of diabolical "awk" code. However, if you read the "man" pages on "awk", you should be able to make some sense of it.

The script can be run with or without arguments. The optional arguments are:

zplog [-a] [-e string] [-f fn] [-i] [-m nm] [-n] [-p] [-s] [-v]

Basically, running the ***zplog*** command displays ipchains packet logs. The optional command line switches can be in any order and using no arguments will display packet logs using defaults (where applicable). Here's what it all means:

-a – show ACCEPTs and MASQs (these are excluded by default).

-e string – gives a string to search for (ie, only include lines containing it). If **-e** is used more than once, then the patterns from all of them are matched (ie, a line must contain all the patterns). Matches are done before the site names, services or ICMP type names from any of **-i -n -p** arguments are included, so you cannot match any of these (you can match numeric IP addresses, services and ICMP types).

-f fn – is the messages file; eg, messages.fn (the default if -f missing). This is useful if the (syslog) messages file has recently been cleared.

-i – show ICMP type names.

-m nm – sets number of messages to display (default is 10 if **-m** is missing).

-n – show the site name by doing a host command on IP addresses. This slows up the log output. Ignored if followed by **-p**.

-p – do a ping on IP addresses to try to get the site name. This is slower than using **-n** but shows you if the site is still on-line when the log is output. Ignored if followed by **-n**.

-s – show the service (port) name for TCP and UDP if it is in ***/etc/services***.

-v – match all but the -e strings (ignored if no **-e's**).

Example logs

In the following examples, there are only five messages shown instead of the expected 10. That's because five duplicates have been removed.

Beefing Up Security On Your Linux Box

Apart from having a good firewall, there are a few other things you van do to beef up security. First, edit the **/etc/hosts.deny** and **/etc/hosts.allow** files so that only PCs on your internal network can access the Linux gateway. That's done by first opening ***/etc/hosts.deny*** and adding the following rule at the end of the commented section:

```
# /etc/hosts.deny
ALL: ALL
```

This tells the "TCP wrappers" to deny connections to all services from all hosts. So we need to weaken this rule by adding some exceptions to **/etc/hosts.allow**, as follows:

```
#/etc/hosts.allow
ALL: 127.0.0.1
ALL: 192.168.0.
```

This tells the "TCP wrappers" to allow connections to services from the local machine (127.0.0.1) and from the local network (192.168.0.). And yes, you must include the full stop at the end of the second line.

Another very effective way to improve security is to shut down any services that you don't need and restrict access to any that you do need. Have a look at the articles published in June 2001, August 2001 and September 2001 issue of SILICON CHIP if you require detailed information on how to do this.

You should also only set up users that you need. If you connect via SSH, you will need one user who can log in (other than root). If you require other users for email, etc, create them with a shell of ***/bin/false*** and a login directory of ***/dev/null*** so they cannot log in.

Do not remove the existing root access restrictions to allow root to log in via SSH (or similar). Instead, log in as a normal user and then use ***su*** to log in as root.

If you use Samba to transfer files back and forth, then don't set up home shares. Restrict access to one share limited to one directory and have a password on it. Make sure you include an interfaces command in your ***smb.conf*** file to stop Samba using the cable modem interface, as Samba by default uses all interfaces.

If you are using a terminal utility to connect to your Linux box, use SSH instead of Telnet and disable the Telnet service. That's because SSH encrypts all data, while Telnet sends plain text (including passwords). Having said that, I have been using Telnet on my internal network for months and have not had any security problems, because the firewall rules and ***hosts.allow*** and ***hosts.deny*** files stop any would-be crackers anyway.

Finally, having a good firewall doesn't mean you can become complacent. Be sure to keep an eye on your log files and remember to install any security updates as the come along.

Just remember this: human beings are clever and resourceful little blighters and no protection system or firewall can be guaranteed to be foolproof.

Note also that these logs were produced by a "stronger" firewall (***cablefirewall.unfriendly***) than the one presented in Pt.3 – one that rejects a lot of outgoing UDP to stop spyware sending things out (the simple firewall presented in Pt.3 doesn't stop outgoing Internet traffic).

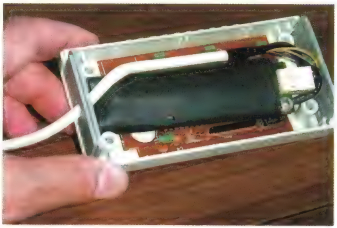
Cablefirewall.unfriendly is too long to publish here but can be downloaded from the SILICON CHIP website. The script is fully commented and experienced Linux users should have little trouble adapting it to their needs. Please note, however, that neither SILICON CHIP nor the author are in a position to offer any further advice on this firewall.

Here are some typical **tail /var/log/messages** packet logs (***grep -e "Packet log:" /var/log/messages | tail***):

```
Aug 22 17:17:15 fire-wall kernel: Packet log: output
    REJECT eth1 PROTO=17 210.49.34.215:61499
    67.233.33.88:1214 L=1341 S=0x00 I=54295
    F=0x0000 T=127 (#15)
Aug 22 17:58:50 fire-wall kernel: Packet log: input
    DENY eth1 PROTO=6 217.225.157.216:2634
    210.49.34.215:21 L=48 S=0x00 I=8952 F=0x4000
    T=113 SYN (#18)
Aug 22 18:13:55 fire-wall kernel: Packet log: input
    DENY eth1 PROTO=6 210.244.158.43:22
    210.49.34.215:22 L=40 S=0x00 I=31977 F=0x0000
    T=122 SYN (#18)
Aug 22 18:14:54 fire-wall kernel: Packet log: output
    REJECT eth1 PROTO=17 210.49.34.215:62017
    68.17.240.77:1214 L=1341 S=0x00 I=29821
    F=0x0000 T=127 (#15)
Aug 22 18:50:48 fire-wall kernel: Packet log: input
    DENY eth0 PROTO=17 0.0.0.0:68
    255.255.255.255:67 L=328 S=0x00 I=0 F=0x0000
    T=128 (#18)
```

Here are the same messages via zplog:

```
Aug 22 17:17:15 output REJECT eth1 udp eth1:61499
    67.233.33.88:1214 (#15)
Aug 22 17:58:50 input DENY eth1 tcp
    217.225.157.216:2634 eth1:21 SYN (#18)
Aug 22 18:13:55 input DENY eth1 tcp 210.244.158.43:22
    eth1:22 SYN (#18)
Aug 22 18:14:54 output REJECT eth1 udp eth1:62017
    68.17.240.77:1214 (#15)
Aug 22 18:50:48 input DENY eth0 udp 0.0.0.0:68
    255.255.255.255:67 (#18)
```



Here's a cunning idea: you can make a dummy keyboard by scrounging the circuit board inside a "real" keyboard that's been discarded. The circuit board can then be housed inside a small plastic case, or even hidden inside the main system case (see SILICON CHIP, February 2002).

And with zplog -n -i -s, we get:

```
Aug 22 17:17:15 output REJECT eth1 udp eth1:61499
       67.233.33.88
       (1Cust88.tnt1.valparaiso2.in.da.uu.net):1214 (#15)
Aug 22 17:58:50 input DENY eth1 tcp 217.225.157.216
       (pD9E19DD8.dip.t-dialin.net):2634 eth1:21=ftp
       SYN (#18)
Aug 22 18:13:55 input DENY eth1 tcp 210.244.158.43
       (c43.h210244158.is.net.tw):22=ssh eth1:22=ssh
       SYN (#18)
Aug 22 18:14:54 output REJECT eth1 udp eth1:62017
       68.17.240.77 (adsl-17-240-
       77.jax.bellsouth.net):1214 (#15)
Aug 22 18:50:48 input DENY eth0 udp
       0.0.0.0:68=bootpc 255.255.255.255:67=bootps (#18)
```

Apart from the fact that ***zplog*** only returns packet logs, the format it returns is a lot easier to interpret. It displays the internal network (192.168.0.x for example) as eth0.x and the external IP address as eth1 (these will be swapped around if you have eth0 and eth1 swapped) to make interpretation easier.

No keyboard or monitor

If you have a method of communicating with the Linux PC other than via the keyboard and screen (eg, a terminal utility such as SSH), you can dispense with the keyboard and screen. The February 2002 issue of SILICON CHIP explained how to do this, by making up a dummy keyboard.

In my case, I had to make up a dummy keyboard in a small box but depending on your BIOS, you may be lucky and not have to do this. My Linux PC also made several annoying beeps when booting if it didn't have a monitor – but it would boot. I found that the "three 75Ω resistors in the dummy SVGA plug" trick cured this (see SILICON CHIP, February 2002).

If you aren't using a screen or keyboard, you won't be using a graphical interface like Gnome or KDE, so you don't need a mouse either! A word of warning though: if you do have a mouse plugged in and remove it, Linux will prompt you about its removal the next time the system restarts. So if you want to remove the mouse, unplug it and restart the system and follow the screen prompts before you remove the screen and keyboard.

Switching off

It's all very well to run your Linux box without a mouse, keyboard or monitor but how do you shut it down in an orderly fashion without these components? Well, if your Linux PC has an ATX power supply, you can download a utility called "Powerswitch" from **http://deadlock.et.tudelft.nl/~joris/powerswitch/** and install it.

The instructions that come with it are easy to follow and once installed, the driver automatically shuts Linux down and powers off the machine when ever the power switch is pressed.

Since the standard Linux modules are in directories within ***/lib/modules***, I created a directory called ***/lib/modules/3rdparty*** and put ***powerswitch.o*** in that but you could put it anywhere. It needs to be loaded on system start up and this can be done by including the appropriate entry (eg, ***/lib/modules/3rdparty/powerswitch*** in ***/etc/rc.d/rc.modules*** file (see Pt.2 of this series in last month's issue).

This module works by trapping the suspend mode and executing ***shutdown -h now***.

Apart from that, there are just a few BIOS settings to tweak. First, the BIOS must be configured so the power switch enables suspend mode when it is briefly pressed (ACPI support = yes in mine). Second, I found that I had to set the CPU and monitor entries to suspend for ***powerswitch*** to activate. And third, it is important to disable all suspend timers in the BIOS, otherwise the PC will shut down when one of these activates!

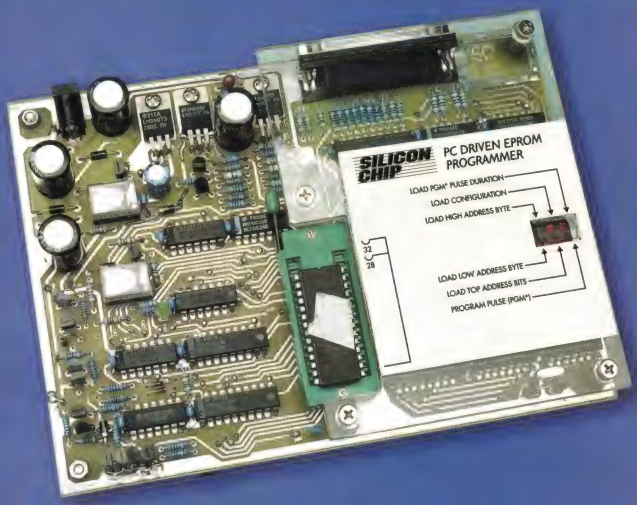
If you cannot get ***powerswitch*** to do a shutdown (or if the system shuts down incorrectly), play around with the power settings in the BIOS.

Provided everything is OK, pressing the power switch will now result in Linux shutting down correctly before the PC switches off.

The ***powerswitch*** module is very handy and does make one lazy! Why log in to shutdown when you can simply turn the PC off? It is also a nice safety feature, as Linux doesn't like being switched off without being shut down in the correct manner. **SC**

DISCLAIMER

Although the two firewalls mentioned in these articles should make for a reasonably secure system (especially if unwanted services are turned off), neither Silicon Chip Publications nor the author can offer any guarantees. If security is vital to your organisation, be sure to seek expert professional advice when it comes to setting up a firewall.



A Windows-Based EPROM Programmer

In this final article, we're presenting the Windows-based software for controlling our new EPROM programmer. We also detail a few modifications which have been made to the circuitry to improve its performance.

Pt.3: By JIM ROWE

DURING THE SOFTWARE development, we encountered a number of problems which delayed its release until now. Some of these problems were caused by timing errors that were encountered when using different settings for the "enhanced" printer port. They were fixed by adding a couple of RC filters. The rest were fixed by adding a few pullup resistors on the data input lines and by eliminating one capacitor.

This means that we are now able to present the software and it's the Windows-based version – not just a clunky interim version written in VBDOS, which looked a strong possibility when the second article was published.

Before I start talking about the software though, let's take a look at the modifications which have been made to the programmer hardware. Incidentally, the revised PC board pattern has been sent to board manufacturers, so the boards you buy or receive in programmer kits should have all the modifications included.

Hardware modifications

The first modification involves adding pullup resistors to the input lines from the printer port connector (CON1) to data buffer IC1 and mode decoder IC3. This prevents the chip inputs from "floating" at indeterminate voltage levels when the programmer isn't connected to the printer port. Leaving the inputs floating makes them prone to induced cable crosstalk and noise (and could even result in damage).

The extra parts involved a SIL (single in-line) array of eight 10kΩ resistors for the data inputs of IC1 and discrete 2.2kΩ pullup resistors on the three inputs to IC3. These are shown at upper and lower left in Fig.11, which shows the modified input and decoding circuitry.

There is one small complication with these changes: if the programmer is now powered up when it isn't connected to a PC, the fact that IC3's inputs are all pulled high sets the programmer into programming mode. This means that if an EPROM is also plugged into the ZIF socket, it will be subjected to the programming voltages continuously.

So it's now important that an EPROM should not be plugged into the ZIF socket until the programmer is connected to a PC's printer port, powered up and set to read mode by the software (which does this as soon as it starts).

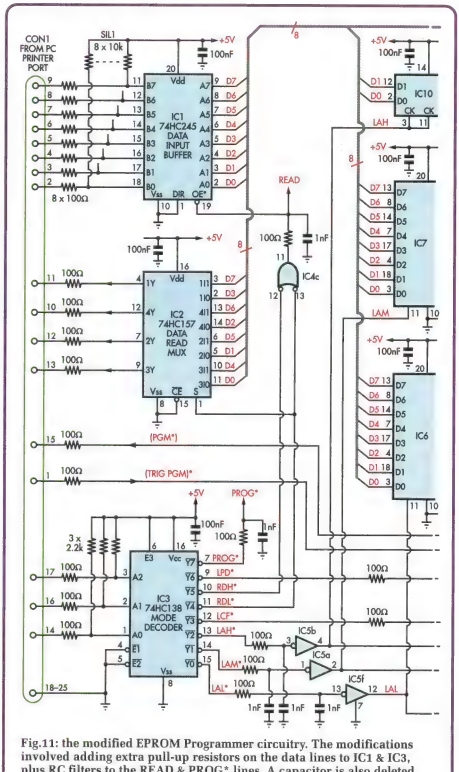


Fig.11: the modified EPROM Programmer circuitry. The modifications involved adding extra pull-up resistors on the data lines to IC1 & IC3, plus RC filters to the READ & PROG* lines. A capacitor is also deleted from another section of the circuit (see text).

Another modification involved adding a couple of RC filter networks. The original circuit showed low-pass RC filters on five of the outputs from mode decoder IC3 (LAL*, LAM*, LAH*, LCF* and LPD*). They were necessary to suppress narrow glitches from IC3, for reliable address and configuration downloading.

Similar RC filters have now also been added to the remaining two mode

Table 1: Programmer Config Byte Control Functions

Config bit	Control Function	Value	Control Effect
CF0	ZIF socket pin 3(1) signal/voltage	Low (0)	Pin 3(1) = address line A15
		High (1)	Pin 3(1) = programming voltage Vpp
CF1	ZIF socket pin 22(20) signal/voltage	Low (0)	Pin 22(20) = PGM* in program mode
		High (1)	Pin 22(20) = CE* in program mode
CF2	ZIF socket pin 24(22) signal/voltage	Low (0)	Pin 24(22) = Vcc in program mode
		High (1)	Pin 24(22) = Vpp in program mode
CF3	ZIF socket pin 29(27) signal/voltage	Low (0)	Pin 29(27) = address line A14
		High (1)	Pin 29(27) = PGM* in program mode
CF4	ZIF socket pin 30(28) signal/voltage	Low (0)	Pin 30(28) = address line A17
		High (1)	Pin 30(28) = Vcc
CF5	Vcc in EPROM read mode	Low (0)	Vcc (read mode) = 3.0V
		High (1)	Vcc (read mode) = 5.0V
CF6	Vcc in EPROM write mode	Low (0)	Vcc (write mode) = 6.25V
		High (1)	Vcc (write mode) = 5.0V
CF7	Vpp voltage	Low (0)	Vpp = 21.0V
		High (1)	Vpp = 12.75V

This revised version of Table 1 shows the corrected entries for the CF1 configuration bit.

lines (READ and PROG*). They provide small time delays which match those caused by the existing RC filters. Both these extra filters are shown in Fig.11 and have exactly the same component values as the originals.

The remaining hardware modification involves removing a component. The original circuit showed a 100nF bypass capacitor from pin 24 of the ZIF socket to ground. However, this line cannot be fitted with a bypass capacitor because it's the EPROM OE* line (output enable/disable) and must be toggled rapidly during programming and data verification. A bypass capacitor slows down the voltage changes quite seriously, so it can't be used here.

The solution to this one was easy – remove the capacitor. It was originally mounted at the very front of the PC board, just below the ZIF socket – see the PC board overlay (Fig.8) on page 34 of Pt.2. It was also shown on the original circuit diagram (Fig.3) on page 27 of Pt.1 and should be deleted.

The revised PC board overlay is shown here as Fig.12 and includes all the corrections. Most of the added components are just above IC1, IC2 & IC3, with the remaining components just to the left of IC1.

Note that to fit in SIL1 (the 8 x 10kΩ pullup resistor array), I had to reduce the mounting centres for nine of the 100Ω input suppressor resistors. This means that these no longer mount horizontally but are instead tilted at about 45°, so their leads mate with the board holes.

Note too that SIL1 is fitted with its "common" pin to the left, just above pin 19 of IC1. If you fit SIL1 the other way around, you'll almost certainly get rather strange problems.

So that's the story on the hardware modifications. Just follow the revised layout shown in Fig.12 and you won't have any problems.

Supplementary Parts List

Capacitors
2 1nF metallised polyester

Resistors (0.25W 1%)
3 2.2kΩ
2 100Ω
1 8 x 10kΩ SIL resistor array, pin 1 common (SIL1)

Delete
1 100nF multilayer monolithic capacitor (near ZIF socket)

Configuration table error

There was also an error in Table 1 (Pt.1, p23), which showed the functions of the CF1 bit transposed. As a result, a corrected version of Table 1 has been reproduced in this article, to avoid any possible confusion.

Any port won't do!

Before moving on to the software, let's first take a look at the various printer port configurations and see how the differences between them can affect the operation of the EPROM programmer and its software.

When the IBM PC first appeared in the early 1980s, it was provided with a fairly basic parallel printer port conforming to the standards originally specified by printer maker Centronics. This "Centronics" type of printer port became the standard for quite a few years but as processors and printers both became faster, various "enhanced" printer port configurations came into use. These provided both faster operation and fully bidirectional parallel data transfer.

When the American IEEE came out with its IEEE-1284 standards (see side panel), PC makers began incorporating multi-mode ports directly into their motherboard chipsets. That's why the CMOS setup program in modern PCs gives you a number of options for configuring the onboard printer port(s) – usually as a "legacy" Centronics port or SPP (standard parallel port), an enhanced EPP port or an enhanced ECP port with DMA options.

We wanted the new EPROM Programmer to be backward compatible with older PCs having only an SPP, so that it could be used with just about any PC. As a result, I originally tested the design using an old 66MHz 486 machine, running a quick-and-dirty test program written in VBDOS (and running under DOS). This machine has only a bog-standard SPP/Centronics port and everything worked fine.

However, when it came to developing the final software using Visual Basic 6, I used a Pentium 3 866MHz machine running Win98SE. This machine allows the onboard parallel port to be set to one of several different modes, so I automatically went into the CMOS setup and configured it as an SPP which seemed like the logical choice.

Unfortunately, I was wrong! It turned out that on both this machine and a Pentium 2 266MHz machine which I tried as well, setting the port for SPP/Centronics mode operation gave all kinds of weird timing problems. In this mode, the ports couldn't toggle the various bit lines in synchronism in response to software instructions. It was only when I tried setting the port to ECP mode (or "EPP+ECP"

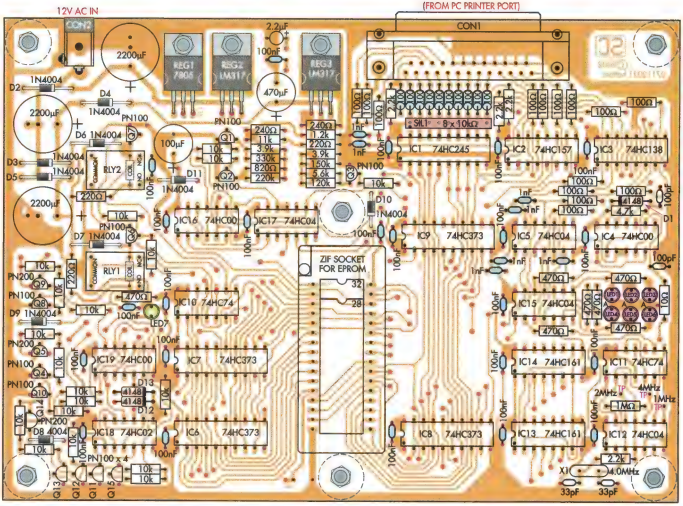


Fig.12: this is the parts layout for the modified PC board. Most of the added components are just above IC1, IC2 & IC3, with the remaining components just to the left of IC1. The deleted 100nF capacitor was originally installed just below the ZIF socket (see text).

mode for the P2 machine), that these timing problems suddenly disappeared.

This means that if you're planning to use the EPROM programmer with a PC that has a multimode parallel port, you'll almost certainly have to set it for ECP or ECP+EPP operation.

By contrast, you probably won't be able to change the port mode on an older PC (eg, a 486) but this shouldn't be a problem – it will almost certainly have an original SPP/Centronics type port which should work OK.

Windows complication

There's another trap for the unwary in using devices like the EPROM Programmer which communicate with the PC via the printer port – especially when the PC is running one of the many versions of Windows. This is because Windows and its printer drivers are very possessive about the port and simply won't let another program talk to it after they have previously used it for printing (during the current session, that is).

This means that if you use the PC's parallel port to print out from a Windows program during your current session, you can't then simply connect the EPROM Programmer to the port and fire up the software to read or program an EPROM. The software simply won't be able to communicate with the programmer if you try!

Instead, you have to reboot the PC to unlock Window's steely grasp on the port and allow the software and hardware to talk to each other.

The software

OK, let's now look at the actual software.

As mentioned earlier, the software is Windows-based and was written using Visual Basic 6. It makes use of a freeware DLL (dynamic link library) called IO.DLL to directly access the parallel port hardware. This DLL was written by Fred Bulback and works with Win95, Win98 and Windows NT/2000/XP.

The DLL file can be downloaded from Fred Bulback's website located at **www.geekhideout.com** and has also been made available in the software package on the SILICON CHIP website.

Thanks to IO.DLL, the VB6 software can send data out via one of the parallel port registers by calling the added subroutine:

PortOut (ByVal PortAddress As Integer, ByVal Data As Byte)

and can retrieve input data nibbles from the port's status register by calling the added function procedure:

ReadVal = PortIn (ByVal PortAddress As Integer)

In each case, PortAddress has a value corresponding to the address of the port register in I/O space.

So that's how the software actually passes data out to the EPROM programmer and fetches it back again.

Software interface

A screen grab of the software's main

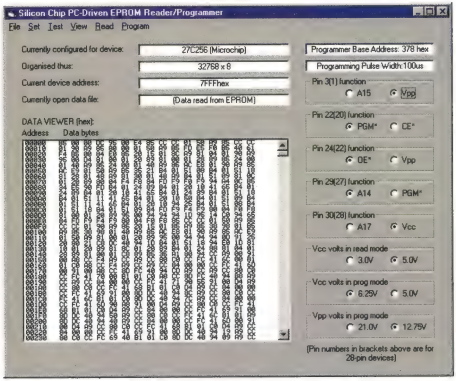


Fig.13: the main interface for the software that's used to drive the EPROM Programmer. It shows all the critical settings and includes a large "list box" that's used to view a data file loaded from disk or read back from an EPROM.

interface is shown in Fig.13. It has the standard Windows appearance, with a menu bar at upper left and a bunch of display windows and option button controls. There's also a fairly large list box at lower left which can be used to view a data file loaded from disk or read back from an EPROM.

The two small display boxes at top right are used to show the I/O base address of the selected parallel port (ie, the one that the programmer is connected to) and the current setting for the programming pulse width in microseconds or milliseconds.

Beneath these boxes are eight pairs of option buttons, which are used to set up the programmer's configuration to suit each different type of EPROM. In the screen grab shown here, these have been set up automatically by opening the configuration file for a Microchip 27C256 device.

Incidentally, I have produced a few of these configuration files for different EPROMs and these will be made available along with the software on the SILICON CHIP website. However, you'll find that it's also easy to produce other device configuration files yourself, using the software and information from the EPROM manufacturer's datasheet.

Basically, you only have to set the pin connections, the supply voltage levels for reading and programming, and the programming pulse width. That done, you simply select File -> Save Device Config (from the menu) and the software guides you through saving the configuration as a file.

Once the device configuration data has been saved to disk, you can set up the programmer for working with that type of EPROM at any time in the future simply by opening that configuration file again. This is done by selecting File -> Open Device Config from the menu.

Two other options in the File menu allow you to open and save an EPROM data file (as you might expect). The software will not only load and save EPROM data in raw binary form but can open files in Intel and Motorola S-record hex formats as well. These latter formats are often used for saving EPROM data.

The final option in the File menu is used to exit the program. Incidentally, when you do exit, the program automatically saves two handy pieces of information to a set-up file: the parallel port address currently in use and the device configuration file currently in use (if any). This information is then loaded by default the next time you fire up the program.

The next main menu option (along from File) is Set. This gives you two options: the ability to set the parallel port base address and the desired programming pulse width in microseconds.

There are three standard base addresses (278h, 378h or 3BCh) to choose from and a dialog which allows you to set the programming pulse width to any value from 1µs to 50ms.

INSTALLING THE SOFTWARE

On the SILICON CHIP website, in the software folder, you'll find the following files: **EPROMP1.CAB** (1,283KB), **EPROMP2.CAB** (373KB), **SETUP.EXE** (137KB), **SETUP.LST** (4KB) and **DEVCFGS.ZIP** (1KB).

Download these files and save them in your PC's ***C:\Temp*** folder. Then from the Start menu, select Run, Browse to ***C:\Temp\Setup.exe*** and click OK to run this file. It's then just a matter of following the simple instructions.

Setup will unpack and install the executable **EPROMProg.exe** in the ***C:\Program Files\EPROMProg*** folder, together with **IO.DLL** and all other files needed to run the program. It will also add a shortcut called ***"Silicon Chip EPROM Programmer"*** to your **Start->Program Files** menu.

After the setup program has finished, open the file **DEVCFGS.ZIP** with Winzip, and extract the sample device config files in it to the **C:\Program Files\EPROMProg** folder, so that they're ready for accessing by the program.

The programming software is now installed, and ready to run. The compressed installation files can be deleted from the ***C:\Temp*** folder if you wish, or saved on floppy disks or a CD-ROM if you want to keep a backup.

Incidentally, along with the **EPROMProg.exe** program and its associated files, the setup program also installs an uninstall log file, **ST6UNST.LOG.** This file is used by the Windows uninstall utility to uninstall all files, if you later choose to remove the software from your computer.

Next along in the main menu options is Test. There's just one option here and that's to confirm that the software can communicate with the EPROM Programmer hardware – ie, that you have selected the right port base address and the programmer is powered up and ready to go (and that Windows hasn't locked up the port)! It does this by making the programmer's LED3 glow and then asking you to confirm that it is glowing. It then turns LED3 off again.

The fourth of the main menu options is View, which again has only one option: to display the currently loaded data which has been either opened from a disk file or read from an EPROM in the programmer. The data is displayed in hex in the viewer window, in lines of 16 bytes, with the address offset shown at the start of each line. The viewer window has a scroll bar so that you can examine every part of the data at your leisure.

Read options

The next main menu option is Read, which gives you two choices. One is to read the contents of any desired address range in the EPROM in the programmer, so you can view the data and/or save it to disk. This option asks you for the start and end addresses for the range to be read but offers the EPROM's own start and end addresses as defaults, in case you want to read all of its content (this depends on you having opened the right device configuration file, though).

The second Read option is Check Erasure, which is provided so that you can quickly check if an EPROM has been properly erased. When this option is selected, the software quickly reads the contents of all addresses in the EPROM, checking to see if they all contain FFh (this is the sign of complete erasure).

It's always a good idea to use this option after you've wiped an EPROM in your UV eraser, to make sure it's ready for reprogramming.

The final main menu option is Program, which provides a list of three options. The first programs the complete EPROM with the data currently in memory – (ie, from opening a disk file or reading another EPROM). The second option programs just a range of addresses in the EPROM, again using the data currently in memory. You can specify just one EPROM address location if you wish, which is good for testing purposes.

With both of these Program options, the software controls the programmer to perform a "fast" programming algorithm at each device address. This kind of programming algorithm does a "verify read" after each programming pulse, to check if the programming was successful. If it was, the address is regarded as properly programmed and the software sends the next address to the programmer.

On the other hand, if the verify read shows that programming wasn't successful, the software directs the programmer to try again with another programming pulse.

This "try again" routine continues until either that address has been successfully programmed, or a total of 10 programming pulses have been used without success. In the latter case, the software stops the programming operation and lets you know that programming failed at the EPROM address concerned.

Don't Skimp On The Programming Cable

Be sure to use a good quality round DB25M-DB25M parallel data cable to connect the EPROM Programmer to your PC's parallel port. Don't use a 25-way ribbon cable with IDC connectors on each end if you can avoid it, because this type of cable has no shielding and degrades the noise and cross-talk performance of the programmer-PC link.

A good-quality round cable, preferably one manufactured to conform to the IEEE 1284 specification, will give you virtually error-free EPROM reading and programming. I found this out the hard way, so be sure to follow this advice. In short, don't skimp on the cable.

This type of fast programming algorithm is now recommended by virtually all EPROM manufacturers, for most modern devices. Each manufacturer tends to call it by a different name, though – eg, "Turbo Programming", "Programming Express", "Flashrite", "Presto II" and so on. The basic idea is that each address is only given just enough short programming pulses to ensure that the data is reliably stored.

As you can see, this type of programming algorithm has built-in data verification while the programming is taking place. Despite this, the third option in the software's Program menu

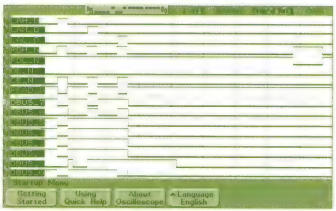


Fig.14: this oscillogram shows the key data and control line waveforms during a read operation – in this case, the read sequence for a single EPROM address at 7FFEh.

Fig.15: the key data and control line waveforms during a programming operation. In this example, the address programmed is 1FE8h and the data is E8h.

About The Various PC Parallel Printer Ports

The parallel port used in IBM's original PC of 1981 – and in just about every clone made during the following few years – was very similar to the Centronics printer port. This in turn had been used on most of the earlier 8-bit computers like the Tandy TRS-80 and allowed 8-bit parallel data transfer from the PC to the printer. However, there were only five lines for transfer of "status" information the other way.

This made it capable of transferring outgoing data fast enough to keep up with a dot-matrix or daisywheel printer but it could only be used for transferring data back into the PC in 4-bit "nibbles" – ie, at less than half the speed.

This type of parallel port is now known as the "legacy", "Centronics" or "standard parallel port" (SPP) and is probably the only type found on every model of PC.

When IBM subsequently released its PS/2 models in 1987, it provided them with an improved version of the SPP which allowed fully bidirectional 8-bit data transfer on the eight main data lines. This type of parallel port was adopted by other makers as well and became known as the "PS/2 parallel port", "simple bidirectional port" (SBP) or "byte mode parallel" (BMP) port.

Not long after this, when Intel produced its 386 processor and its associated chipset, it collaborated with computer makers Zenith and Xircom to produce an enhanced parallel port which would allow much faster bidirectional data transfer than the SPP or SBP. This new port became known as the "enhanced parallel port" or EPP and was designed to speed up both printing and communication with peripherals like scanners, memory, tape drives and even external disk drives.

The EPP specification allowed for fast byte-wide transfer of both data and address information in both directions and was widely adopted in computers based on the 486 and later processors.

Then in the early 1990s, yet another type of enhanced parallel port appeared: the "extended capability port" or ECP. Originally proposed by Hewlett-Packard and Microsoft, this soon became incorporated into the new IEEE 1284 standard specification entitled "Standard Signalling Method for a Bidirectional Parallel Peripheral Interface for Personal Computers", which was released in March 1994.

As well as establishing a full standard for very fast byte-wide transfer using an ECP, IEEE 1284 also formalised the specifications for the existing EPP, SBP and SPP port configurations. At the same time, it also established standards for the cables and connectors to be used with each type of port, for optimum performance.

In most PCs manufactured in recent years, the primary parallel port is incorporated inside one of the motherboard chipset ICs. Many of these onboard parallel ports can be configured by the BIOS firmware to emulate any of the types of port we've mentioned above – or at least some of them. This configuration is done using the CMOS setup utility, which can usually be entered during bootup by pressing the <DEL> or <F2> key.

is Verify, which allows you to do a complete re-read of an EPROM and have its contents compared with the data currently in memory.

This option might seem unnecessary but it has two uses. The first is obvious: it allows you to make doubly sure that an EPROM has been correctly programmed with the data. The second use is for re-reading an EPROM you've just read, to make sure the Read operation did indeed retrieve a faithful copy of the EPROM contents. If Verify gives the "all clear", the re-read data compares exactly with the data you read the first time.

OK, so that's a quick rundown on the **EPROMPrg.exe** program, the features it provides and how it's used.

Key waveforms

Figs.14 & 15 are screen grabs from SILICON CHIP's Agilent 54622D Mixed Signal Oscilloscope/Logic Analyser. They show key data and control line waveforms during a read operation (Fig.14) and a programming operation (Fig.15).

In Fig.14, you can see that a read sequence for a single EPROM address (here address 7FFEh) takes about 40µs. The first 15µs are taken by the address downloading (high bits, middle byte and low byte in that order), while the high data nibble is read after the address has stabilised and then the low data nibble at the end of the sequence.

Fig.15 shows a programming sequence which is successful after a single 100µs pulse, so it is complete after about 160µs. The address programmed is 1FE8h and the data programmed into it is E8h. You can see the address download at the start, the 100µs long programming pulse in the centre (PGM_N and CE_N lines) and then the verify read operation at the end (far right).

Note that during EPROM Read, Check Erasure, Program and Verify operations, the software displays a graphical "progress" bar at lower left (just below the viewer window). This lets you observe the progress of the selected operation.

Finally, the program is available for download from the SILICON CHIP website (**www.siliconchip.com.au**), together with IO.DLL and some sample EPROM config files to get you going (see panel). We are also providing the VB6 source code for the program, for those who'd like to see for themselves just how it does what it does.

Hotshot programmers might also want to improve it in various ways – feel free to modify it to meet your needs.

Happy EPROM programming! **SC**

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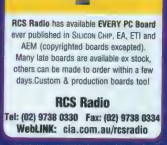

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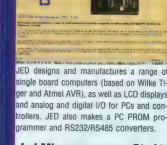

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VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Aligning the front-ends of TRF & superheterodyne receivers

In the last two issues, we've looked closely at the IF stage in superhet receivers. This month, we take a look at the RF (radio frequency) circuits in TRF receivers, the local oscillator stage in superhets and at receiver alignment.

TRF (tuned radio frequency) sets were the most common receivers in the 1920s but their popularity rapidly decreased as the superhet became dominant in the mid 1930s. However, some manufacturers still produced cheap and simple TRF sets that could be used in high-signal strength areas. A typical set of this type is the Astor "Football" from the 1940s.

TRF radios had from one to four tuned stages. Initially, it wasn't necessary to have the stages track one another as individual variable capacitors were used to peak each station. However, this was quite a chore and the radio manufacturers soon decided to mechanically couple all the variable capacitors together in the more elaborate receivers – eg, by using brass straps and dial drums.

This made tuning much easier but it also meant that the sets had to be designed so that each stage tuned to the same frequency across the dial – ie, the stages had to track each other. However, in many cases, no attempt was made to accurately align each stage for best performance.

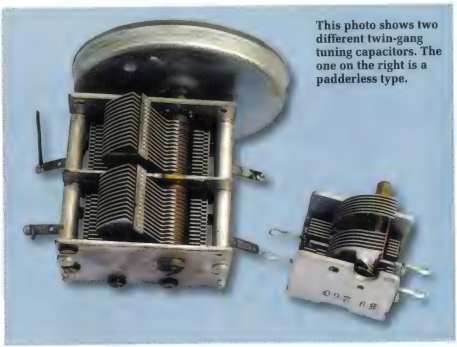
Later on, a trimmer capacitor was placed across each tuning capacitor. This meant that all tuned circuits could be set to the same frequency at the high-frequency end of the dial, thereby ensuring the best performance possible.

By contrast, accurate tracking at the low-frequency end of the tuning range relied heavily on the accuracy of the winding of the tuning coils. This was helped by the fact that distributed and stray capacitance around the tuned circuit was less of a problem than at the high-frequency end of the tuning range. And as time progressed, manufacturers were able to wind the coils with quite high accuracy, which meant that it wasn't really necessary to later adjust the inductances.

However, I have found that almost all air-wound RF and antenna coils give improved performance at the low frequency end of the dial if an adjustable slug is incorporated in the coil design. Some older coils suffer from moisture ingress over the years and this causes the inductance to alter and the quality factor ("Q") to decrease, thereby lowering the gain of the stage.

In order to assess alignment accuracy, it is best to measure the effect of any adjustments on the receiver. If the set has AGC, a digital multimeter (DMM) connected across the diode load or AGC line will indicate peak performance, as described in the previous two articles on IF amplifiers.

However, many sets do not have diode detectors or AGC, so measuring



This photo shows two different twin-gang tuning capacitors. The one on the right is a padderless type.

the audio level across the speaker terminals is one of the few options left. Note that this can only be done if a signal generator with tone modulation is used. If the alignment is done only on the apparent aural difference, the accuracy will be limited, so it's best to measure the output if possible.

It's also important to realise that a receiver front-end that's been aligned with a signal generator connected to it will no longer be correctly aligned when connected to an antenna. To overcome this problem, I adjust the signal generator output to a high level and wrap the test lead around the antenna lead. That way, the signal generator does not detune the antenna tuned circuit to any extent and the signal level into the set is relatively low.

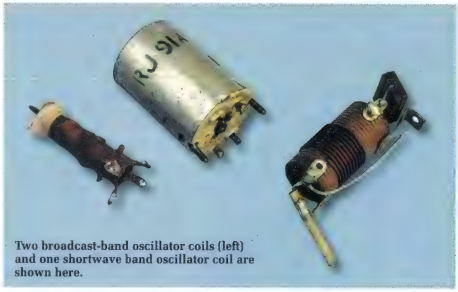
PEAKING AIR-CORED TUNING COILS IN TRF SETS

These coils are usually wound solenoid fashion on coil formers ranging from 25-75mm in diameter. Some of these coils are in aluminium cans while others are left unshielded. Invariably, they don't have iron dust cores to adjust their inductance, to ensure accurate tracking across the band.

It is fairly easy to determine whether the tuned circuits do track accurately. To do this, first tune to the high-frequency end of the tuning range and adjust the trimmer capacitors for best reception, with the trimmers nominally at half capacitance. It doesn't matter whether the stations are tuned at the correct spot on the dial for this test.

Now tune to a low-frequency station. Make a note of where each trimmer is set, then vary the trimmer capacitance up and down in each tuned circuit and note the position where peak performance occurs. Return each trimmer to its start position before adjusting the next trimmer.

Note whether more or less capacitance is needed to peak the performance in each case (sometimes, you may need more capacitance, in other cases less capacitance). If the trimmer has to be screwed further out (less capacitance) for peak performance, it indicates that the tuned circuit has too much inductance and a turn or two of wire may need to be removed to improve the tracking. Conversely, if the trimmer has to be screwed in further, it indicates that the inductance is insufficient and a turn or two of wire will need to be added.



Two broadcast-band oscillator coils (left) and one shortwave band oscillator coil are shown here.

As a matter of fact, I had a 1931 Operatic TRF with this problem. In that case, removing two turns from one coil allowed the two tuned circuits to track each other.

Another method of checking the tracking is to get a small length of ferrite rod and with the set tuned to the low-frequency end of the dial, insert the rod into each coil and observe whether the performance improves or deteriorates. If it improves, more turns are needed and if it gets worse, fewer turns are needed. If there is no change in the performance, it is accurately tuned.

Some later receivers with air-cored RF and antenna coils can be converted to slug tuning for improved sensitivity. I've done this to several receivers by placing a small-diameter slugged coil former inside the air-cored coil. This is held in place by soldering the coil former lugs (no winding on the former) to the larger coil lugs, so that the former sits quite securely inside the air-cored unit.

This works well and will noticeably lift the performance of some sets.

ALIGNING TRF RECEIVERS

TRF receivers are relatively easy to align, as we shall see.

First, if the coils have no iron-dust cores, no alignment adjustments can be done at the low-frequency end of the dial – unless you are prepared to

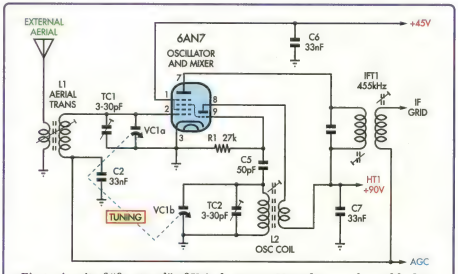


Fig.1: circuit of "front end" of Kriesler 11-90. Note the use of a padderless tuning gang (VC1a & VC1b).

This photo shows the dual-wave coil assembly from a wrecked receiver. The two coils can be seen at top-right of the metal sub-chassis.

try the techniques previously mentioned to match the inductances in the various tuned circuits.

If the inductances do prove to be matched, it's a matter of adjusting the dial scale so that the tuned station appears at the right spot on the dial. This is done by loosening the dial scale pointer or grub screws holding the dial drum to the tuning capacitor and adjusting its position, while still listening to the station. It's then just a matter of retightening the screws.

Now tune to the high-frequency end of the dial and note where a particular station appears. If it tunes with the gang further out of mesh than it should be, adjust the trimmers for less capacitance until the station appears in the correct position. Conversely, if the gang is further in mesh than it should be, increase the trimmer capacitance.

Note that it is necessary to check the tuning at the low-frequency end of the dial following any adjustments at the high-frequency end, and vice versa, until the stations appear in the correct positions.

Aligning a TRF with slug-tuned RF and antenna coils is straight forward. In this case, it isn't necessary to muck about with adding or subtracting turns on the coils as occurs with some older sets.

Generally, the frequencies at the ends of the dial travel are marked in some way. If not, just assume that later receivers tune from 540-1620kHz, while older sets tune from about 550-1500kHz.

First, tune the receiver across the band and note where stations appear on the dial. Alternatively, if you have access to a signal generator, check the entire tuning range. If stations are consistently displaced (eg, by 10mm) from the correct positions on the dial, it is necessary to adjust the dial pointer by a similar amount in the opposite direction to correct this inaccuracy. A set that has all the stations displaced by a similar amount is likely to be reasonably well aligned. However, it will still have to be peaked for best performance.

Starting at the low frequency end of the dial, adjust the coil cores until the sought after station (about 600kHz) appears at the correct spot on the dial. That done, tune to a high-frequency station (about 1400kHz to 1500kHz) and adjust the trimmers for best performance. Note that some adjustment may be necessary to get the station to appear at the correct spot.

If you find that you have wound the iron cores right into or out of the coils and the trimmers right in or out and the performance is still poor, reset them all to half-way and try again. However, it's also possible that one or other of the tuned circuits has a fault and no amount of adjustment will overcome the lack of alignment.

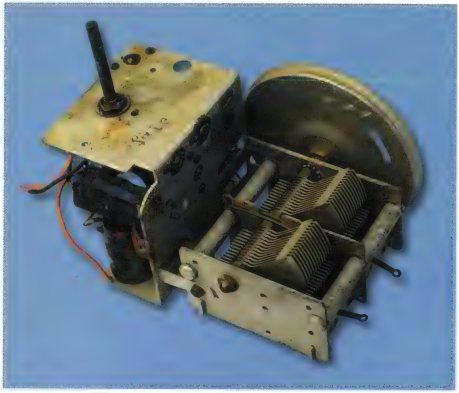
Alignment of TRF receivers on shortwave bands involves the same principles as those used on the broadcast band. However, there aren't many shortwave TRF sets about and those that do exist tend to have fewer tuned circuits (often only one in a regenerative detector circuit).

THE SUPERHET RECEIVER

The RF and antenna circuits of a superhet receiver are identical with those used in TRF sets of the same era. Instead, the big difference between the two types of sets is in the variable tuned circuits, due to the addition of a local oscillator in the superhet. This local oscillator is tuned to a frequency that's offset from the antenna and RF circuits by the intermediate frequency (IF).

In most sets, the IF is 455kHz and the local oscillator must accurately maintain this offset right across the band. This is not an easy task. Receivers using tuning gangs with identical capacitance ranges (plate shape) will usually only have the local oscillator displaced exactly 455kHz from the signal frequency circuits at three spots across the tuning range.

This means that the tuning of a superhet receiver can vary sufficiently for differences in sensitivity to be apparent across the band. However, this is mainly a problem in earlier sets – later receivers use automatic gain (volume) control (AGC) and therefore these inaccuracies are hardly noticed.



Another view of the dual-wave coil assembly from the wrecked receiver.

On some "broadcast band only" receivers, it became reasonably common to use a twin or triple section tuning gang which had one section specifically for the oscillator tuning. This section usually had fewer plates and they were shaped differently to achieve accurate tracking. These are called "padderless tuning gangs" as no padder was required.

The miniature tuning gangs used in broadcast-band transistor sets are of this type too. One such tuning gang can be seen in one of the photos, where one section is noticeably smaller than the other. The smaller section is used for the oscillator. The maximum capacitance for each section is 210pF for the signal frequency section and 90pF for the oscillator section.

By the way, I have several transistor sets (different brands) that use the 3-gang version of this tuning capacitor (MSP). Unfortunately, I have found that the oscillator and the antenna and RF tuned circuits do not track, not matter what I try do to overcome the problem. Whether this was just a faulty batch or is due to some other problem, I don't know. On the other hand, my Kriesler 11-90 and 11-99 sets use another brand of padderless gang and they track perfectly. As a result, their performance is very good.

Padderless tuning gangs are only suitable to use on the broadcast band and in sets with a 455kHz IF. They can be designed for other bands and IFs but I've not seen any. Where multi-band operation is required, all sections of the tuning gang are identical.

ALIGNING THE FRONT-END OF A SUPERHET WITH A PADDER

Early superhet receivers used air-cored coils in both the RF/antenna circuits and the local oscillator. This meant that it was necessary to have some means of adjusting the oscillator at both the low and high frequency ends of the dial, so that the stations were at their correct locations on the dial.

This was achieved by having an adjustable padder (mounted on the chassis) to align the circuit at the low-frequency end of the dial, plus a trimmer capacitor to align the high-frequency end. There was only one adjustment for the antenna or RF coil and that was done at the high-frequency end of the dial.

The first step is to shift the dial pointer (if necessary) so that it has equal overlap at either end of the dial scale. Then, with the receiver operating, check that the stations are received at the correct dial locations

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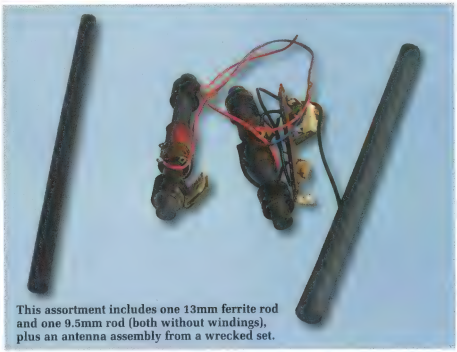

This assortment includes one 13mm ferrite rod and one 9.5mm rod (both without windings), plus an antenna assembly from a wrecked set.

(they probably won't be at this stage).

Next, at the low frequency end (around 600kHz), adjust the padder so that a known station appears at the correct dial location. That done, go to the high-frequency end (around 1400-1500kHz) and adjust the oscillator trimmer so that a known station appears at the correct spot. For best results, double check these two adjustments.

Next, adjust the antenna/RF circuit trimmer(s) at around 1500kHz for best performance. Now if all is well, the set is correctly aligned.

In some cases, however, the alignment may not be correct for the antenna and RF circuits at lower frequencies. To check this, slide a small ferrite rod into these coils and observe any differences in performance, as described earlier for TRF receivers.

If the performance improves, this indicates that the antenna/RF coils have insufficient inductance. In that case, there are three ways in which the alignment can be improved:

(1) Overwind a few turns (experiment with the number) of enamelled copper wire onto the coil. That done, connect one end in series with the grid end of the coil and the other end to the point in the circuit where the grid connection had originally been made.

(2) Install a small amount of ferrite material inside the coil.

(3) Reduce the "apparent" inductance of the oscillator coil by reducing the padder value. This means that the tuning capacitor plates have to be more in mesh for a given oscillator frequency.

Method three is the easiest to implement. First, tune to a weak station at the low-frequency end of the dial. Now adjust the padder so that the station appears closer to the end of the dial and note any improvement in signal strength. Keep doing this until no further improvement can be obtained.

It is then necessary to alter the dial pointer so that it points to the appropriate frequency or marking on the dial scale. That done, readjust the oscillator alignment at the high frequency end of the dial and peak the RF/antenna circuit(s).

However, in some cases, it many no longer be possible to receive all the stations that should be received. The receiver may now only tune from (say) 600-1600kHz instead of 550-1600kHz. If this proves to be the case, then this particular method of obtaining the best performance at the low-frequency end of the band isn't appropriate. Instead, one of the other methods must be used – or you can just forget about getting the best performance at the low-frequency end of the dial.

If the antenna/RF coils have too much inductance, there are only two ways of improving the low-frequency alignment:

(1) Do the same as (1) above (ie, by overwinding the coil), except the turns must now be in series opposing; or

(2) Adjust the padder to higher values of capacitance so that the tuning capacitor plates are further out of mesh for a given oscillator frequency. That done, continue to adjust the circuits in the same way as mentioned above, except that the padder is continually increased in value. Do this until the performance is at its best.

ALIGNING FRONT-ENDS WITH IRON DUST/FERRITE CORED COILS

It is much easier to adjust the front-end of a receiver if all the coils have iron-dust or ferrite cores, plus trimmer capacitors. However, you must use a non-metallic alignment tool to make the adjustments if the core is inside the coil.

The first step is to adjust the dial pointer so that it travels from about the 520kHz mark (ie, maximum capacitance) to about the 1620kHz mark (the exact frequencies at either end of the band will vary from model to model). That done, tune to a frequency around 600kHz and adjust the oscillator so that the station appears at the correct spot on the dial, then tune to around 1400kHz or 1500kHz and do the same by adjusting the oscillator trimmer.

Repeat this procedure until the stations appear in the correct positions on the dial (or as near as practical).

Now do exactly the same thing for the antenna and RF coils but use a frequency nearer 1600kHz for the high frequency adjustment. Note that these adjustments should be carried out with the set coupled to the antenna. In each case, you adjust the coils and trimmers for a signal peak by measuring the AGC or detector output voltage, as mentioned earlier in the article.

When ferrite rod loop antennas are used, the coil (or a small auxiliary coil) is simply slid along the rod for best performance at the low-frequency end of the dial. It's then locked in position with some bees wax (or similar).

The nominal value of the padder capacitor for the broadcast band and a 455kHz IF is 425pF. For a 175 kHz IF, it is around 550pF or higher. On the shortwave bands, the padder value can vary from upwards of 2200pF to 4500pF. In some cases, the manufacturers didn't worry about tracking

Photo Gallery: National Panasonic R-100 4-Band 9-Transistor Radio

Purchased at a charity bazaar a few years ago for the princely sum of $10, this National Panasonic R-100 4-band 9-transistor radio was the top-of-the line model from Matsushita in the late 1960s.

Covering the range from 525kHz to 26.1MHz, the R100 has an IF of 470kHz. Most of the transistors are on a tightly-packed PC board but the oscillator and antenna coils are chassis-mounted, as are the band switch and trimmers.

Weight without batteries is 4.2kg. This unit has been modified to run from a 9V DC plugpack and still performs very well. (Note: if anyone has a manual, please contact Leo Simpson).

on the shortwave band and dispensed with the padder altogether.

RECEIVER ALIGNMENT ON SHORTWAVE BANDS

On the shortwave bands, the local oscillator operates above the received frequency – with a few exceptions. The alignment procedure is the same as for the broadcast band. However, the problem of image breakthrough is quite evident, as discussed in the earlier articles on IF alignment.

Assuming that the IF is 455kHz, a station on 17MHz will be heard on the receiver dial at both 17MHz (or close to it) and at 16.09MHz (the image frequency). For this reason, make sure that the antenna/RF coil(s) are peaked on the 17MHz frequency.

Unfortunately, shortwave stations are often difficult to identify. Several frequencies often carry the same program and fading is common, all of which makes alignment rather difficult.

It's best to use a signal generator for this job, as this eliminates any ambiguities in the results. Once again, tune the receiver to about 17MHz, then adjust the signal generator to 17MHz. Adjust the receiver for a response on or near 17MHz, then shift the signal generator frequency until the receiver responds to another frequency.

It should respond when the generator is shifted to 17.910MHz if the receiver is reasonably well aligned. However, if it is badly out of alignment, the response will be at 16.09MHz instead.

The correct alignment frequency is the lower generated signal. If the response is at 16.09MHz, the oscillator trimmer will have to be reduced in value so that the receiver can respond at 17MHz, as marked on the dial scale. The RF/antenna coil trimmers are adjusted for peak performance on this frequency, if the tuning range is 6-18MHz.

Shortwave bands are very approximately aligned, with few receivers having accurate dial calibrations. In fact, shortwave bands on many sets were purely a selling point, with poor performance, poor dial calibrations and inadequate alignment facilities.

SUMMARY

So that's it – a comprehensive alignment procedure for most TRF and superhet receivers. In summary, the general procedure is to adjust the coil cores (or padders) at the low-frequency end of each band and the trimmers at the high-frequency end for peak performance. That said, you should be guided by the alignment procedure for each model if this is available. **SC**

Tracking down an elusive fault in Windows XP

By STEPHEN DAVIS

Tracking down an elusive fault in your PC's operating system can be a frustrating and time-consuming exercise. Although used to solve a particular problem, the approach described here can be applied to tracking down other faults as well.

When a fault or a glitch appears in your PC's operating system, the first question you must ask yourself is "How far am I willing to go to fix this problem?" After all, many problems can be fixed simply by reinstalling the operating system and provided you have backed up important files, there is nothing wrong with this.

However, this method does have two important drawbacks: (1) it leaves you none the wiser as to what actually caused the problem in the first place; and (2) you risk losing settings and software updates that you may have spent a lot of time getting right. As a result, many people prefer to troubleshoot any problems as they arise, if only to satisfy their own curiosity or to meet a challenge.

And – dare I say it? – fixing a crashed computer can actually be a lot of fun.

Desktop folders won't open

In this article, I am going to give you the step-by-step process I used to fix a strange fault in my own computer. This fault would always appear after what appeared to be a normal boot-up. Quite simply, folders on my desktop wouldn't open when double-clicked. Instead, the cursor would bring up the "hourglass" icon and just "hang" there.

What's more, when ever I gave the computer the three finger salute (Ctrl-Alt-Del) to bring up the Task Manager, there would be no application running in the foreground to turn off. And the taskbar at the bottom indicated that CPU utilisation was running at 100%!

So what was causing this problem? I hadn't added any new software lately; nor had the computer recently crashed or done anything else unusual.

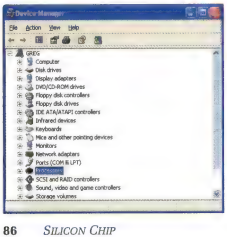

Fig.1: checking the Device Manager will quickly reveal if there are any resource conflicts or hardware problems.

Safe mode

Initially, I decided to restart the computer in safe mode (by pressing F8 during the boot) to see if this gave any clues. Fortunately, the folders now opened up normally, so I was not hampered by that particular problem.

I had been on the Internet the night before and although any downloaded material is automatically checked by a virus scanner, I decided to do a thorough virus scan as a first step. That step quickly excluded a virus infection as being the cause of my problems.

Next, I had a cursory look in Device Manager (Fig.1) to see if any obvious faults were present. However, having had a stable system running for quite some time (and with no new hardware recently added), I wasn't surprised to see that everything was normal.

Registry rollback

The next consideration has to be a corrupt registry, so I rebooted into safe mode and "rolled back" the registry to a date when I knew the folders opened normally (see Fig.2). That's one very worthwhile feature of XP – you can easily rollback the registry to an earlier time. Unfortunately, the problem was still present in normal mode, so I rebooted into safe mode again and ran Scandisk and Defrag to exclude the possibility that file allocation or disk corruption errors were causing the problem.

The hard disk was given a clean bill of health and, as I quickly found out, the problem remained.

The next step was to get back into normal mode and use the Windows Configuration Utility so that the normal startup runs in diagnostic mode. Typing "msconfig" in the "Run" dialog box brought up the configuration utility and I selected "Diagnostic Start Up".

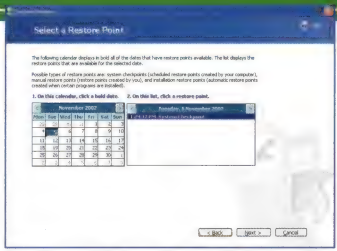

Fig.2: Windows XP's System Restore utility lets you roll back the system to an earlier date when everything worked normally. This utility is accessed through the Start menu.

After rebooting, the folders now opened normally but of course, I now had none of the services that allow the computer to be usable. By a process of elimination, I was then able to quickly show that the problem was in the "services" area and not in the "start-up" or ".ini" files. This was done by selecting "Selective Startup" (Figs.3 & 4) and enabling one group but not the other before rebooting, then doing the reverse.

By using the same process of elimination within the "Services" group, I found that the folders would open normally if "WebClient" was disabled. To check what this service actually does, I went into Start, Control Panel, Administrative Tools, Services, and looked up "WebClient". This is what I found there: "WebClient enables Windows-based programs to create, access and modify Internet-based files. If this service is stopped, these functions are no longer available. Services that depend on it will fail to start".

It also showed that the executable for this service was svchost.exe in the system32 folder.

As a result of disabling this service, programs such as Acrobat Reader, Eudora and Internet Explorer would no longer load. However, Netscape Navigator continued to work perfectly and could access the Internet via a dial-up connection. It obviously didn't need the WebClient service.

System file checker

A corrupt file now looked a distinct possibility so the next step was to run the System File Checker. This was done by booting into normal mode and typing "sfc /scannow" in the "Run" dialog box.

I had been fairly confident that this would fix the problem, so you can imagine my frustration when, at the end of the file check, the original fault was still there. Perhaps not fully accepting the result, I then used the "repair" option available during the Windows XP reinstallation procedure, using the original CD to replace the system files in the Windows directory. But again, there was no joy.

Incidentally, I was impressed by the fact that this procedure apparently changed none of my settings or hardware configurations. However, anyone who has Windows XP preinstalled by an OEM should look at Microsoft's Knowledge Base article on this subject before attempting this procedure.

Safe mode vs diagnostic mode

My next step was to think about the difference between safe mode and diagnostic mode in normal startup. The folders opened normally in safe mode and Acrobat Reader, Internet Explorer and Eudora all worked normally.

At this point, I enabled logging during both safe mode and diagnostic mode boot up. By then reading the ntbtlog.txt file in the Windows directory and highlighting the differences between the two boots, I found that non-Microsoft files were present in diagnostic startup but not present in safe mode.

These non-Microsoft files included port drivers, sound drivers, modem drivers, an Nvidia video card driver and Norton's Internet Security filter.

Next, I uninstalled the video and sound drivers and installed the latest updates (why waste the opportunity?). I also disabled the Norton filter file, along with the modem and port drivers (by going into the driver

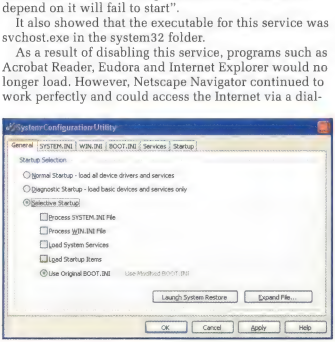

Fig.3: the System Configuration utility lets you load only selected services and devices at start-up.

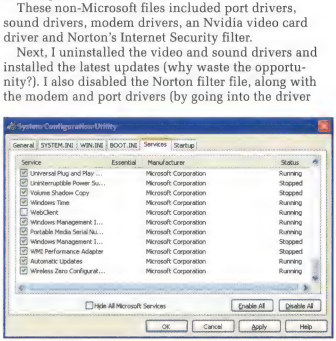

Fig.4: in this case, disabling WebClient allowed all folders on the desktop to open normally.

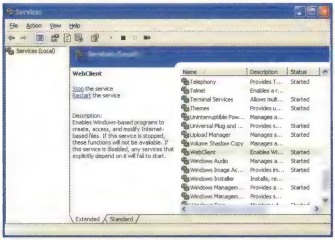

Fig.5: you can quickly find out what a particular service does by going to Start/Control Panel/Administrative Tools/ Services. In this case, the WebClient description is shown.

directory and renaming them). The problem was still present!

However, one thing I did notice was that those programs that refused to load when the system was in normal mode would, in fact, finish loading as the system was shutting down. In addition, a window would appear to indicate that an error had occurred.

In Windows XP, "dwwin.exe" is the Microsoft error reporting utility and this puts the error message into a format that can be sent to Microsoft. In my case, I disabled this file (by renaming it), so that any errors would be reported in readable format on the screen as they occurred. I then rebooted the computer in normal mode (with "WebClient" disabled) and tried to start Internet Explorer, which I knew would fail to load.

I then clicked Start, Turn Off Computer, Restart and as the computer was shutting down, Internet Explorer started to finish loading. And as it did so, up popped the following message just before reboot: **"The instruction at 0x7621a4ca referenced data at 0x0176d000. The required data was not placed into memory because of an I\O error status of 0xc0000010"**.

Exactly the same error occurred at the same memory location when I rebooted and did the same thing with Adobe Acrobat Reader. I then did an Internet search on this error but could find very little information about it. Furthermore, there was no information about the error in Microsoft's Knowledge Base.

Of course, I didn't really know whether this error was due to the original fault or because I had disabled "WebClient". However, it did cause me to think about the possibility of a physical memory fault. It occurred to me that either the physical memory was faulty or that this error was the result of a memory allocation problem for some reason.

To test the physical memory, I downloaded the *memtest.exe* utility from **www.memtest86.com** and allowed this to thoroughly test the machine's memory. This ran for some 12 hours and tests both the SDRAM and on-board caches. The result was clean bill of health for the system's physical memory.

Event Viewer

By this stage, I was running out of ideas so I went to the Administrative Tools section in the Control Panel and opened the Event Viewer. Of course, errors here would probably be the result of disabling "WebClient" but I was getting desperate.

In the System section of the Event Viewer, there were two error messages that had been repeated a number of times. These were: (1) **"The SYMTDI service depends on the TCP/IP protocol driver service which failed to start because a device attached to the system is not functioning"**; and (2) **"The IPSEC Service depends on the IPSEC driver service which failed to start because a device attached to the system is not functioning"**.

Yet another message appeared in the Application section: "Faulting application explorer.exe, faulting module wininet.dll".

In order to make absolutely sure that neither *wininet.dll* nor *explorer.exe* were corrupted, I renamed both files (in the *system32* and *windows* folders respectively) and did another file check by typing ***sfc /scannow*** in the Run dialog box. This forced the System File Checker to install new versions of these files on the hard disk, direct from the CD but the problem remained.

The SYMTDI service is the Norton Internet Security Filter and I had checked this previously. Similarly, the IPSEC service is the Microsoft Internet Security Service and was included in the operating system files that had already been checked for corruption. So what was left?

By now it was obvious that the fault was connected with the Internet modules in the operating system, because it disappeared when "WebClient" was disabled. In addition, the faults listed in Event Viewer all pointed to Internet modules, *wininet.dll* being the Internet extensions dll for win32. And the fact that Netscape Navigator could still be used, despite Internet related software problems, pointed the finger at Internet modules that were associated with Microsoft.

The thought dawned on me that Internet Explorer itself could be the problem, since this has files deeply embedded in the operating system. As a result, I started poking around at the folders associated with Internet Explorer and quickly found that I couldn't open the "Temporary Internet Files" folder. Despite the fact "WebClient" had been disabled, this one folder wouldn't open but instead caused the computer to hang.

The conclusion was almost an anticlimax. After booting into Safe Mode, I deleted the offending folder, then rebooted into Normal Mode again to regenerate the "Temporary Internet Files" folder. The operating system then behaved normally again.

So that was it – the Temporary Internet Files folder was corrupt and for some reason (probably known only to God and to Microsoft), it affected every other folder. I was lucky that I had enough time to track down this fault but I now appreciate more fully why so many people chose reinstallation as a first option when strange faults appear. **SC**

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Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097; or send an email to silchip@siliconchip.com.au

240VAC electricity distribution

I've always wondered why there are four electrical wires on top of the power poles but only two wires come into our house, and my neighbour has three wires going into their house.

What are the reasons? Does it mean my neighbour uses more electricity than I do? Someone told me that 3-phase electricity supply requires four wires; is that the reason? (K. W., via email).

● Electricity distribution in the street is three phases of 240VAC and the neutral connection. Most houses only have two; ie, 240VAC (one phase) and neutral. Some houses have two phases (three wires) while some have all four because they are running a pool heater or some other big appliance which needs 3-phase 415VAC.

Revox A78 amplifier for cannibalisation

My trusty and much-used Revox A78 40+40 watt stereo amplifier has recently suffered a catastrophic blow-up. It is built like a tank but since it is over 20 years old, no serviceman will accept it for repair.

I was advised that one of the power lines failed but that the power transformer is in good order.

At the moment it languishes in my garage since I am reluctant to throw it on the tip. I have the user's manual but no circuit data. If any reader can find a use for it as a source of spare parts they are welcome to contact me at *juniper1@tpg.com.au*. (I. J., via email).

Pink noise for environmental masking

I have just completed the Personal Noise Source for tinnitus sufferers from your September 2001 edition. It worked first time I powered it up!

I do have two questions though: first, the specs define the external power supply to be 12V but I did not notice any components between this input and the 9V battery. Does this mean that the device can also be powered by an external 9V source as well?

Second, I want to use the device with a hifi system to provide environmental noise masking. Although I am aware that the headphone output can be plugged into the RCA aux input of the amplifier (with the volume control set to a suitable level), is it possible to take an output from the circuit board (at an appropriate level) which bypasses the volume control? (R. C., via email).

● You can operate the noise source from 9V instead of 12V. You can take an output for connection to a stereo system from across the volume control potentiometer.

Capacitors for RIAA preamplifier

I am about to build the RIAA preamplifier described in the March 2002 issue but am having troubles sourcing some capacitors. Can you help me with their supplier? The capacitors I need are 2 x 270pF MKT polyester, 2 x 100pF MKT polyester and 2 x 33µF 16V PC bipolar electrolytics. (F. P., via email).

● You can use polystyrene capacitors from Dick Smith Electronics or ceramics (available most kitset suppliers) for these small values. Tolerance is not critical in these circuit positions. 33µF BP capacitors are available from Jaycar Electronics.

Increasing the range of the 0-80A ammeter

I have just built the 80A ammeter from the June 2002 issue of SILICON CHIP and it appears to work extremely well. I have also built two digital voltmeters for the two batteries in my main vehicle. Because of the vehicle wiring I can only display the discharge current from the battery and not charge. Discharge is via a separate cable while charge comes through the main starter cable. My question is can the ammeter be upped to 120A?

Both my vehicles are Landrovers, a 3.9-litre petrol V8 and a new TD5 diesel. The main vehicle is the diesel and this has an electronic injection 5-cylinder motor. Both vehicles run alternators of between 100A and 120A. Both vehicles also run fairly decent lighting as well, so the 80A ammeter goes into overload. (J. G., via email).

● The ammeter cannot be changed to show over 99A since the left-most digit is only there to provide a minus sign.

You could, however, divide down the Hall effect sensor output by a factor of two. This would then show readings which are half of the true value; eg, 120A would show as 60A. This could be done by connecting a 47kΩ resistor across the 10µF capacitor at pin 2 of IC2a.

High energy ignition problems

I assembled the High Energy Ignition kit (June 1998) for use on a points-triggered Nissan Patrol. On completion I found that Q1 would not switch. After checking component values and the circuit, I found that pin 7 of IC1 was not dropping low. I further found that Q2 was not dropping the collector low.

On investigation, I found that pin 5 of IC1 would not drop low when Q2 was biased on. The circuit shows DC blocked by a 10nF (.01µF) capacitor. This is the problem. If that capacitor was jumpered, the system worked OK except of course, the dwell delay

Tone control mods for guitar preamp

I have some queries concerning the November 2000 guitar preamp kit. I noted the modifications proposed by a reader in the October 2002 edition to lower the turnover frequencies for the mid and treble tone controls for use with a bass guitar. The treble was originally set at a 10kHz turnover frequency. For use with a regular electric guitar, isn't this frequency too high?

I don't know the highest frequency an electric guitar can produce but note that most guitar speakers have a range no higher than around 5kHz. I built this amp for my son, who commented that it is not as bright as his smaller commercial combo unit. The treble adjustment on this kit is barely audible – the mid has a more profound effect and the bass is terrific.

I also built the reverb kit and note that at volume settings on the preamp any higher than moderate (>1/4 turn of the input level pot), the unit produces a "metallic" sounding reverberation. It is hard to describe in writing – the sound is particularly noticeable on the bass strings, does not appear with lower volume settings and is triggered when the string is plucked, and sounds, well, imagine that the perforated steel speaker grill has a bundle of aluminium cans hanging off it.

My son thinks it sounds great – I think I have done something wrong. Can you confirm it is normal? (B. R., via email).

● The treble action will depend on the guitar. You can reduce the frequency of boost and cut in the same way as described for the bass guitar modification. You may not want to reduce the frequency as far for a lead guitar and so an intermediate capacitor value may be more appropriate.

The metallic sound with the reverb is normal and is due to too much reverb effect being applied.

would not work. The capacitor was replaced to no effect. Even if the collector of Q2 was jumpered to earth, the circuit would not work.

A link was inserted from the "points" position on the circuit to the "coil" position provided for the programmable ignition module. I could find no mention of such a link being required in the circuit or circuit description.

I would like confirmation that my modification will not effect the dwell timing. I don't think it will. (C. H., via email).

● As always, if you are building the Programmable Ignition Timing module and the High Energy Ignition system, you should get the ignition system properly working on your vehicle before linking it to the PIT module.

Shorting out the .01µF capacitor between the collector of Q2 and the 22kΩ resistor going to pin 5 of IC1 will disable the dwell extension facility. Since you are able to measure the switching of Q1 when the points are open and closed with the dwell extension out (shorted .01µF capacitor), it is most likely that the circuit does work correctly with the .01µF dwell extension capacitor in circuit.

This is because the switching of Q1 will not be noticeable when using a multimeter, as it switches off for only 0.9ms. You should be able to monitor this switching with an oscilloscope.

If no oscilloscope is available, test the circuit on your vehicle with the dwell capacitor in circuit. It is highly likely that it will work correctly. Then you can hook up the PIT module.

Multi-Spark CDI substitution questions

I have a couple of questions regarding the Multi-Spark Capacitor Discharge Ignition featured in the September 1997 issue of SILICON CHIP. I live in the Netherlands and am having trouble finding some of the parts for this project.

My first question concerns Mosfets Q6 & Q7, which are IRF822. I was wondering if I could substitute IRF820 or IRF830? Their specs look much the same but they are able to handle bigger currents.

My second question is about IC1 and IC2, which are both IR2155. Is there any substitute for those ICs? There isn't a lot of information on the Internet about this IC. Is International Rectifier the only manufacturer? (D. G., via email).

● The IRF820 or IRF830 can be used. The IR2155s are made only by International Rectifier. They are available from Farnell Maarssen in the Netherlands. Phone 31 30 241 7373 or log on to **www.farnell.com**

5-chime diesel horn wanted

I would love to have a diesel horn sound on my train layout but can't find one anywhere. There are plenty of engine simulators but no horns. Would it be possible for SILICON CHIP to come up with one, preferably a 5-chime horn rather than 3 or 2. (R. B., via email).

● We described a 3-chime diesel horn in the July 1994 issue in an article entitled Steam Train Whistle and Diesel Horn Simulator. Each of the chimes used an op amp oscillator, with one capacitor determining the chime frequency. It would be a simple matter to add another two chime op amps if you wished.

Provided you know the chime frequencies you want, it should be a simple matter to scale the capacitor values accordingly. If you don't have it, we can supply the July 1994 issue for $8.80, including postage.

Water level indicator for turbo cooler

I would like to adapt the water level indicator, described in your April 2002 issue, for use in monitoring the water level of a turbocharger cooler tank in a car engine. I hope you can answer some questions I have.

(1) The sensor probe will only be 30cm long x 5mm OD. I am looking to have three sensors to indicate contents. Will the turns ratio and wire diameter have much effect on the efficiency of the sensor? (2) For 3-LED operation, can I simply omit appropriate resistors at the voltage divider of Q1 and LEDs from IC1? (3) The DC supply for vehicles ranges from 12V to 13.8V. A 12V regulator would be inappropriate.

Would connecting a 12V zener be a better solution? If so, what would be the best connection method? Also, would any additional filtering be

needed (ferrite beads, rings, etc)? (G. T., via email).

● The number of turns and gauge of wire will not affect the readings of water depth. For a 3-LED indicator, LED1 and LED2 can be omitted as well as R1 and R2. The circuit can be powered from a lower voltage regulator instead. A 9V type would be suitable (78L09) or (7809). The diode bridge (D1-D4) is not necessary and you can place a link and resistor in their place.

In other words, use a link for D4 and delete D3 and D2 on the overlay. Replace D1 with a 10Ω 0.25W resistor. A 16V 1W zener should be placed between the input and ground of the regulator, with the cathode (striped end) towards the input.

If you want to use a 12V zener, use this in place of the 16V zener described above, delete the regulator and short the 'in' and 'out' holes on the PC board for the regulator. Use a 68Ω 0.25W resistor instead of the 10Ω resistor described above.

You may also wish to use the coolant sensor featured in the coolant alarm from the June 1994 issue of SILICON CHIP instead. This provides a single level alarm indication.

24V operation for fluorescent inverter

The 40W fluorescent inverter described in the September 2002 issue appears to be almost exactly what I am looking for. However, I need it to run just as efficiently from 24V (mobile workshop). Is it possible to make some mods to allow it to operate from 24V? (I. C., via email).

● 24V operation could be achieved by (1) changing ZD1 to a 12V 1W zener; (2) increasing the 10Ω resistor feeding ZD1 to 330Ω 1W; (3) increasing the 100Ω resistor feeding IC3 to 1kΩ 0.5W; (4) using 3 turns for the primary of T1 instead of 4 turns; and (5) using 48 turns for the secondary instead of 134 turns on T1. You will also need to include the other modifications listed on page 92 of the January 2003 issue.

Check that IC1 and IC3 receive nominal 12V and 15V supplies respectively, when operating.

Applications for Megger tester

I am trying to gather some information on Megger (insulation) Testers. So far all I've come across is specifications and where I can purchase them.

What I'm trying to find out is what the main purpose is, how they work, and a few examples of when they would be used in an application? (B. F., via email).

● Meggers are widely used in industry to test the insulation of appliances at a specified high voltage (typically 500V). For example, it is essential that washing machines have a good insulation against the incoming 240VAC otherwise they present a big electrocution hazard to users. We published a high voltage insulation tester in the May 1996 issue. We can supply the issue for $8.80 including postage.

Wideband AM radio for rural areas

A recent question about a circuit diagram for an Allen Wright Wideband AM tuner sent me looking through my articles on quality AM radio. I found an EA review on it and also reviews of the Audiosound AM 100, the EA HiFi AM tuner and your own AM stereo Walkman radio.

I also found on the Internet details of Motorola's AM stereo chips, Toko coils and Murata wideband AM filters. Some years ago I built a Playmaster 138 tuner (EA December 1972) but unfortunately it tended to drift over several hours.

Which brings me to the point of my missive. In the capital cities, the ABC is on the AM band (country folk get the ABC on FM!) and there are no plans to move it to FM. Is a new wideband AM tuner a possibility? I did think that something similar to the AM 100, tuned by varicap diodes with an IF of 450kHz, using Toko coils and a notch filter at 9kHz, a signal meter and simple frequency counter may be a possibility. (I. F., via email).

● You may want to consider our wideband AM stereo tuner described in the February, March and April 1991 issues. We can supply these issues for $8.80 each, including postage.

Chaser lights for fountain

I have an outside pond with recirculating water and a fountain head. With the aid of Waterproof Bostick epoxy, I have positioned four high brightness LEDs in red, blue, green and yellow colours. I have coupled these to a kit purchased from Dick Smith Electronics that has four outputs that can act as a chaser, sequencer, etc.

What I really want to do is have

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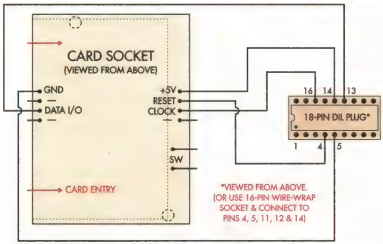

Fig.1: this circuit shows how to hook a smart card to a PIC programmer.

Reader/Programmer for Smart Cards, January 2003: this project can only be used to read and program the EEPROM in a card where the PIC microprocessor has already been programmed. However, the PIC in a blank card can be programmed quite easily using a standard PC-driven PIC programmer, such as the one published in the March 2001 issue of SILICON CHIP. All that is needed for this is to make up an adaptor so that the card can be connected to the programmer's 18-pin PIC socket.

To make up an adaptor, mount a card socket identical to the one used in the January 2003 programmer (ICA-7000, Jaycar Cat No. PS-0012) on a small piece of matrix board, so you can make connections to its card contact pins. Then using the above diagram (Fig.1) as a guide, connect the pins to an 18-pin DIL plug using a short length of rainbow ribbon cable. The DIL plug can then be plugged into your PIC programmer's ZIF socket.

Note that if you can't obtain an 18-pin DIL plug, you can use a 16-pin wirewrap DIL socket and change the pin connections as shown. Then the 'tails' of the socket can be plugged into the programmer's ZIF socket. Just make sure you plug it in at the pin1/18 end, so that the correct connections are made.

5A Universal Motor Controller, October 2002: Fig.4, the overlay diagram on page 17, shows the device installed for SCR1 as an MCR100. If you fit a C103B, remember to reverse the device so that the flat on the package faces down; ie, towards the edge of the PC board.

Capacitor Leakage Adaptor for DMMs, December 2002: the maximum supply voltage to this circuit should be limited to 30V DC.

Gear Indicator, January 2003: the parts list should include 2 x 4.7kΩ resistors. Also the 400mm of 0.8mm tinned copper wire can be 100mm in length. The 2.2kΩ resistor shown on the overlay diagram to the right of VR1 should be 4.7kΩ.

Midi-Mate Interface for PCs, February 2001: it has been found that the MIDI-in port does not work with all PC sound cards. The simplest solution is to increase the value of the resistor in series with LED1 to 680Ω (from 330Ω) and then fit a 470Ω resistor on the underside of the PC board so that it is in parallel with the series combination of LED1 and the 680Ω resistor; ie, from the +5V rail directly to pin 13 of IC1.

each colour turn on for say 30-45 seconds (by itself), switch off and at the same time the next colour turn on – sort of a sequencer situation but with each colour staying on for at least 30 seconds.

Are you able to suggest a way to modify the kit for longer 'on' times? (K. J., via email).

● We assume you are referring to our design published in the March 1994 issue. It is quite simple to slow it down. Just change the 2.2µF capacitor to 47µF tantalum and change the 100kΩ trimpot to a 680kΩ resistor.

Interfacing the stepper motor controller

I have read and thoroughly enjoyed the articles on the Stepper Motor Controller (May 2002) and the Rolling Code 4-Channel UHF Remote Control (July 2002). My interest is in regards to interfacing these two projects so that I can use the UHF remote to control the direction of a stepper motor.

The project is intended to revolve a car amplifier from the roof (laying horizontal) down 90° to a vertical position and reverse, using one channel each of the UHF remote output relays to switch the driving stepper motor forward and reverse (that's the plan).

Obviously, this would only be done when the car was parked and the intention is to use these circuits from your magazine for car shows. The other two channels on the UHF remote control system are to be connected to 12V solenoids mounted in a frame so as to lock the subwoofer boxes into the car boot area and prevent them from being stolen. One channel would fire two solenoids into the locking position and the 4th channel would unlock them.

So, my question is what do I need to do to interface these two projects in order to be able to remotely control the stepper motor direction? (R. W., via email).

● The relays of the UHF remote will do the job directly. Use them to control direction.

Connect the DIR input to +5V via a 10kΩ resistor and then pull this input low via a relay to change direction. Use the other relay to link the OSC and Step terminals for stepping. **SC**

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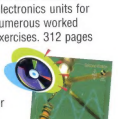

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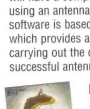

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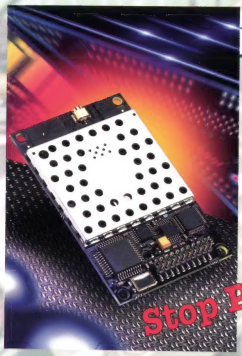

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